Geo. G. Bush

London 1855

THE ART of METALS,

In which is

Declared the manner

OF THEIR

GENERATION,

AND THE

CONCOMITANTS

Of Them.

In Two Books.

Written in *Spanish* by *Albaro Alonso Barba*, Master of Art, Curate of St. *Bernards* Parish in the Imperial City of *Potosi*, in the Kingdom of *Peru* in the *West-Indies*, in the Year, 1640.

Translated in the Year, 1669.
By the R. H. Edward *Earl of* Sandwich.

London: Printed for *S. Mearne*, Stationer to the Kings most Excellent Majesty. 1674.

THE

THE PREFACE.

Gentle Reader,

THou haſt now in thy hands a Jewel ſo eſteem'd in Spain *and the* Indies, *that there they ſell ev'n all they have (and the Kingdom of Heaven to boot) to purchaſe it; for having this they think that therewith they ſhall have all things (in this world, I mean) given unto them: And in that Countrey, I muſt tell you, it will go a great way toward the purchaſe of the other. Indeed there are ſome in all Nations that will ſell that they have not, nor ever ſhall have; but this was a Jewel ſo rare that few had it to ſell, for it was concealed like the great* Arcanum, *the Philoſophers Stone, and only traditionally delivered to the* Adepti, *but it falling into the hands of this true Nobleman of* England, *he not envying the reſt of Mankind ſo great a Benefit, nor being willing ſo*

great a Treaſure ſhould be wrapt up in a Napkin, he honoured and enriched our Language with it, being contented that all our Lord the Kings People ſhould be Philoſophers. Concerning him I have nothing to ſay, he having written his own Hiſtory in ſuch indelible Characters of Gallantry and Honour, that neither Sea nor Earth can contain them: And as he had few or none before him whom he could imitate, ſo I fear he hath left but few behind that will care to follow his generous Example.

The

The manner how Mettals and other ſubſtances that accompany Them are engendred.

CHAP. I.

Of the Companions of Mettals, and firſt of the Earth, and the ſeveral Colours thereof.

ALL the inanimate things within the bowels of the Earth are reducible into one of Theſe Four Kinds of mixtures, *viz.*

Either { *Mettals*, *Stones*, *Earth* or *Juices*. }

Nature produces. Theſe mingled one with the other, and becauſe the art of ſeparating of Mettals cannot be put in practice without underſtanding the nature of the other three, (as will hereafter appear) therefore I ſhall treat of Theſe a little.

By the word Earth I do not mean that pure and ſimple Element, whereof the Philoſopers ſay all mixed ſublunary bodies are compoſed.

Neither do I mean that which is ſo groſs as it remains mixed with Mettal, Vitriol, or other Juices.

But I mean ſuch an Earthy ſubſtance as neither melts in the fire, nor diſſolves in the water, as Mettals and Juices do, nor is ſo Compacted or hard as are Stones.

Some report *Ariſtotle* to have been of Opinion, that the pure Elementary Earth was void of Colour. *Strabo* affirms it to be white, becauſe Aſhes are of

of that Colour, but the Miner may reſt ſecure, that Dig he never ſo deep, he ſhall not meet with any ſuch pure Element of Earth to make new experiments by, becauſe it is not in the world by reaſon of the perpetual mixture of the Elements one with the other.

The Colour of the pureſt Earth that hath been found, *Cardona* would have to be, a very dark Grey: In the other ſorts of Earth we ſee how rich nature hath adorned the world with variety of Colours, cauſed by difference of Exhalation, as *Theophraſtus* ſays, or by difference of heat, as *Ariſtotle* ſays, and both truly; for if under Earth, that hath not its natural and proper colour, there be found Mettals, it is certain, that the exhalations from Thoſe Mettals hath diſcoloured the ground; and if there be no Mettal found there, then the diſcolouring proceeds from the conſuming power of the Suns heat. Beſides the diſcolouring that comes by reaſon of exhalation carries a gliſtering and ſhining along with it, and the diſcolouring from the Suns over-concocti-

on only, is obſcure or Iron-colour'd, or Black.

From what is already ſaid, conſiderable conjecturs may be made for the finding out of Mines in the Bowels of the Earth, by the Colour of the Ground and Cliffs, or by the Tilth ploughed up upon the Mountains, as daily experience hath ſhewn all over the Dominions of *Spain*.

CHAP. 2.

Of the divers Smells of the Earth, and the reaſon thereof.

THe works of Nature in producing variety of Smells of Earth, is alſo worthy of admiration.

Ordinarily the Earth ſmells well upon the fall of the firſt rains after the heat of Summer is paſt: The Dry time having baked together the moderate humidity that was in the Earth, (which is the cauſe from whence all good ſmells proceed) and the firſt rains diſſolving that

that again (which being exhaled by moderate heat) makes the good ſcent which we perceive. Some ſorts of Earthen veſſels alſo have this priviledge, as that of *Eſtremos* in *Portugal*, and of *Nata* (in *Panama*) which are highly eſteemed in *Europe* for that quality. In the famous City of *Malacca* (in the *Eaſt-Indies*) they ſay there is a ſort of Earthen veſſel that ſmells admirably, in ſo great abundance, that it is little eſteemed, and they make all their moſt ſervile ſort of ware of it. And in ſome Mines good ſmelling Earth hath been met withal, although moſt commonly that kind of Earth is of an ill ſcent. *Agricola* relates, that when *Henry* Prince of *Saxony* was in *Mariemburg*, there came ſo ſweet a ſmell out of the Mine, which they called *St. Sebaſtian*, that the Prince admired thereat, and ſaid, that he thought he was in *Calivet*, (that famous Country of the *Indies*, which for its rare ſmells and other excellencies hath been thought by judicious men to be the Paradiſe wherein *Adam* of old, and the Fathers now enjoy

joy God upon Earth) The Mettal that comes out of the Mines (which they call *Palos*) is of a good ſmell, if they light not upon ſome baſtard Mineral, that accompanies, and has infected it: and this good ſmell is a great ſign of the richneſs of the ſtones of that Mine, and of the Earth which they get, there called *Lampos*. This experiment is ordinary in Lead or Tin Mines; and it is uſual for the Miners to judge of their Oar, by the ſmell, as well as by the taſte. Other ſorts of Mettal for the moſt part have an ill ſmell, either becauſe of their own natural diſtemper, or by reaſon of their being generally mixed with Brimſton, Copperas, or other malignant juices.

Some do think, that over and above what hath been ſaid, there is ſome matter in the Bowels of the Earth ſo ſtinking and abominable, that it doth correſpond with the Ordure of Animals: the truth is, that there be places in the Earth that inſtantly kill, with a Peſtilential ſmell. And ſetting aſide the ſtories of this kind, both ancient

and

and modern in remote Countries. I ſhall relate two examples, where I my ſelf was preſent, which was at the diſcovery of the rich Country of *San Chriſtoval delos Lipes*; at that time in a beautiful high hill, that together with others encompaſſes the dwelling of the Miners, two Galleguares found a Mine, which at firſt they called after their own names, but ever ſince (to this preſent) it is called (from its effects) The ſtinking Mine. At firſt they got out of it very rich Oar (*Tacana*) between white Chalk: and as they began to ſink deeper, they were forced to give over, by reaſon of a moſt abominable ill ſmell they met withal, which killed ſeveral of the Miners *Indians*: and ſo it lay unwrought for four or five years; after which time another Miner (I being then in the Country) undertook to proceed in the working of it, thinking that having layn ſtill ſo long after its firſt opening, the ill quality would have been evaporated; but that experiment coſt the lives of two *Indians* more, whereupon they forbore the work, and

have done ſo unto this day. The which I have not ſo much wondred at, as to ſee with my eyes the Ground opened in ſeveral other parts of that Mountain, at a great diſtance from the forementioned Mine, and in digging ſcarce a yard deep, ſuch a ſtink came out of the ground, as forced the labourers to give over; and as I paſſed by thoſe Pits a few days after, I ſaw divers Birds and Serpents dead in them, having been entoxicated by that poyſonous ſmell: On the other ſide of this forbidden Hill (until Divine Providence make way for the Mining of the ſame) are built dwelling houſes, and a Mill to Grind Mettals withal, adjoyning unto a Mariſh Ground, which in every place where they digg'd to lay the ſhallow foundations of thoſe buildings, the ſame ſmell breaks out, as hath been already deſcribed; and it comes out of the ground boiling like unto a Cellar full of Wine on the Muſt; exceeding troubleſome and noiſome unto us, though we were ſtanding by in the open air.

In

In the famous Country of Mines, *Verenguela de Patages*, in which the *Indians* procured a Patent to dig, before that of *Potosi* was in uſe, becauſe its veins were eſteemed much richer than *Potoſi*, and upon trial were found to be ſo; and the Oar gotten there inferior to none in the *Indies*. In the hill of that Country called *Sancta Juanna*, a Miner followed a very rich and plentiful vein of Silver, and intending to diſcover more of the like, he determined to break a hole into an old Vault*, and ſet two *Indians* upon the work, who after a few blows diſcovered a vacuity, out of which came ſo Peſtilential a ſtink, that killed the two *Indians* preſently, and almoſt ſtifled others that were at a diſtance from them in the Mine, who nevertheleſs ran out, and told their Maſter what had happened. He made haſte to the Mine, hoping to ſave the *Indians*, but at firſt entrance into the ground, upon the ſtairs by which they went down into the Mine, he fell down dead,

* *An uſual practice among the Miners in that Countrey.*

dead, and his body remained there, no body daring to go down, and take it away to bury it.

In another Mine in the ſame mountain, in the bottom of it, I ſaw a thick exhalation or poyſonous vapor guſh forth, making a terrible noiſe, and was of quality bad enough to kill one that would ſtay long in that Mine; putting out the Candles, when we held them to it, which is a certain ſign of the malignity of the air, as hath been found by the conſtant experience of all Miners, and therefore deſerves to be the more taken notice of.

CHAP. 3.

How to know the Condition of the Earth by the Taſte.

THe Artiſt in the knowledge of Mettals, before he gives his judgment, leaves no experiment untried, that may be conſiderable for his information. And therefore uſeth his Taſte, which

which diſcovers the pureneſs of Mettals, as well as ſmelling doth.

Pure Earth hath no manner of taſte; and that Earth which is mixed with Minerals commonly hath a bad taſte; becauſe ſcarce any Mineral but is aduſt, and they be all dry, when as the very firſt principle of ſweetneſs or good taſte is humidity.

Now ſince the Earth which hath ſuch a mixture in it is greatly diſpoſed alſo to contain mettals of like condition; The curious Miner ought to make trial by taſting, holding it for a certain truth, that mettals of Gold and Silver, and others, are found as often in the form of Earth (which in the *Spaniſh* Miners language is called *Lampos*) as in Stones or Oar.

The taſte of the Earth is gotten well by infuſing it in curious water, eſpecially if you ſet it upon the fire, and let it boil once or twice, and then cool again, whereby may be diſcerned the mixture or juice which it contains: and one that would improve this experiment may ſeparate the water from the infuſion, ſubſtantially and viſibly, as

ſhall

ſhall be ſhewn in its place, when we come to treat of the Preparation of Mettals, to make them beneficial.

CHAP. 4.

Of the Names and Uſes of ſome ſorts of Earth.

IN the books of Phyſick ſome kinds of Earth are very famous, for the effects which they have upon mans body; and it is not unneceſſary that the Miner hath the knowledge to diſtinguiſh them when they come in his way.

1. *Lemnian*-Earth (ſo called from the Iſland *Lemnos*, where it is found) is very red, and much like unto red Oaker or red Lead, but it hath this notable difference, that it will not colour ones fingers in touching it, as do the others. It is eſteemed as rich as Gold, and ſold ſo weight for weight; one cauſe of the dearneſs of it is the ſcarcity of it in the world; and another is,

is, because they dig it only on one day in the year, being superstitiously perswaded, that that Earth of this kind only hath vertue in it, that is dug upon the $\frac{6}{14}$ of *August*. It is a rare Antidote against any kind of poyson or Pestilence.

2. That Earth which is commonly called *Bol Armeniac*, (from the vulgar opinion, that it is found only in *Armenia*) is very like the *Lemnian*-Earth aforesaid, only it is not red, but palish, white or sallow-coloured. There is excellent good of it, and in great plenty in the *West-Indian* Mines, and particularly in the rich mountain of *Potosi*: and in those of *Oruro* divers are of opinion, that this common *Bol* is that which *Dioscorides* calls *la Rubrica Synopica*: and that the Oriental *Bol Armeniac* is the true *Lemnian*-Earth.

3. There be two sorts of *Eritrian*-Earth, one pure white, the other of an ash-colour, and this last is the better, and is known by rubbing it upon polished Copper, where it will leave a tincture of violet colour. It hath vertue

to ſtench blood, and to cool and heal green wounds.

4. The Earth of *Samia* is light white Earth, and will ſtick to ones tongue, if you touch it with it.

It is brittle, and yet will melt.

There is another ſort of it called *Aſter*, that is cloſe and hard as a ſtone.

Both of them have the *Eritrian* vertue in them; *viz.* to be excellent Antidotes againſt poyſon, or the biting of Serpents.

5. The Earth called *Chia* is white, inclining to aſh-colour, much like that of *Samia*, and hath the ſame vertues; and over and above that, it takes wrinkles out of the face, and gives a good complexion.

6. *Selinuſion*-Earth hath the ſame quality as the laſt aforementioned. The beſt kind of it is that which gliſters much, is white and brittle, and ſooneſt diſſolves in water.

7. *Cimolian*-Earth is white, (although there be a ſort of it that enclines unto purple.) The beſt is that which is moſt greaſie, and is very cold in ones hand.

It

It diſſolves impoſthumes, and little ſwellings, and in caſe of a burn it will keep the fleſh from bliſtering.

8. The *Poigite* is almoſt of the ſame colour as the *Eritrian*, but is found in bigger lumps: it cools and refreſhes the hand that touches it, and if one lick it, it will ſtick much unto the tongue. Its vertues are thoſe of *Cimolian*-Earth.

9. The *Melian*-Earth is of an aſh-colour like *Eritrian*, but it feels rough, and makes a noiſe between the fingers like a *Pomice*-ſtone: it has the vertue of *Allum*, (but very weak, as one may perceive by the taſte) for it will make the tongue ſomething dry: it cleanſes the body, gives a good complexion, and will cure the Itch.

10. Of that Earth which is called *Ampelites*, the blackeſt is the beſt. Ground with Oyl it eaſily diſſolves, and hath a cooling and looſening vertue: alſo it is uſed to colour hair withal; it is wholly bituminous as Jeat is alſo.

Cardanus amongſt his curioſities makes mention of another kind of Earth, anciently called *Britanica*;

(from the Country where it is found) they were fain to dig very deep Mines to come at it. It was white, and after they had ſeparated the Plate it contained, they manured their Tilth-fields with the Earth, which were put in heart thereby for 100. years after.

11. Out of Iſlands in the ſouth Sea, not far from the City of *Arica*, they fetch Earth that does the ſame effect as the laſt aforementioned. It is called *Guano*, (*i. e.* Dung) not becauſe it is the Dung of Sea-fowls (as many would have it underſtood) but becauſe of its admirable vertue in making ploughed ground fertile. It is light and ſpungy. And that which is brought from the Iſland of *Iqueyque* is of a dark grey colour, like unto Tobacco ground ſmall. Although from other Iſlands nearer *Arica*, they get a white Earth inclining to a ſallow, of the ſame vertue. It inſtantly colours water whereinto it is put, as if it were the beſt leigh, and ſmells very ſtrong. The qualities and vertues of this, and of many other ſimples of the new world,

are

are a large field for ingenious perſons to diſcourſe Philoſophically upon, when they ſhall bend their minds more to the ſearching out of truth than riches.

CHAP. 5.

Of Juices, and firſt of Allum.

THe compoſitions within the bowels of the Earth are ſuch as either will melt, or will not melt.

Thoſe that will not melt are hard, and called Stones; or being ſoft and eaſily crumbling into very ſmall parts, are called Earth.

Thoſe that will melt, are either ſuch as after they run (by the force of the fire) become ſolid and malleable; and thoſe are Mettals; or elſe ſuch as do not obtain thoſe qualities, and thoſe are they that are called Juices.

From the mixture of the aforeſaid four kinds of compoſitions are made eleven other ſorts of Minerals, and no more.

Thoſe who are hardned by cold, ungive again by heat, as Sulphur; but ſuch as are condenſed by heat are diſſolved again by cold, and water, *viz.* Allum, Copperas, Salt, *&c.*

1. Thoſe that write of ſimple medicaments ſpeak of divers ſorts of Allum, but the true Allum is that which is called Rock-Allum, whereof ſome is white and tranſparent as glas, and other ſome inclining to a red, and this hath the beſt vertue, and is mightily reſtringent; and therefore called by the *Greeks Eſtypteria.*

According to the opinion of *Galen*; *lib.* 4. of the quality of ſimples: it ſhould be of a cold quality, becauſe all aſtringent things are ſo, and preſcribes therefore *Rupeciſſa* as cold in the ſecond degree to be infuſed in the quinteſſence of *Raymundus.* But *Dioſcorides*, and many others make it to be of a hot quality by its effects; but this is not a convenient place to examine the reaſons of it.

2. The *Allum* which is called *Eſcayola*, is not a Juice, but the ſame with the

the Earth of *Samia*, which the ancients called *Aſter*.

3. Neither is the *Allum ſciſſile*, or *de pluma*, a Juice, (which is yet taken for ſuch in Apothecaries ſhops) but is the Stone called *Amianto*; and it is not aſtringent to taſte, nor conſumes in the fire, although it be kept there very long, which are the particular qualities of an *Amianto*.

4. The *Allum Catino* is made of the Aſhes of the herb *Anthide* or *Soſa*, (*Barilla*, or the herb they make glaſs of) whereof there is great abundance in the plains of *Oruro*, and in ſeveral places of the river *Langa-Sollo*.

5. The Salt which is made of the Lees of Wine, or of the Calcinings of the Lees until they become white, is likewiſe called *Allum*.

the *Weſt-Indies* abound in *Allum*, as they do alſo in all ſorts of Minerals. In the Mines of the *Lipes*, near unto *Coloha*, the head Town of that Countrey, I found a vein of *Allum*; I have ſeen another in the hot Baths of *Ventilla*, in the high way between *Oruro* and *Chayante*;

ante; and there I saw the true *Seissile-Allum*, (or *de pluma*) with all the qualities described by *Dioscorides*. This same sort of *Allum* also is brought to *Potosi*, from another Mine near to *Porco Aylo*: and in many other parts there is of the same; and there might of it be made in the City of *Potosi*, if they would but boil the waters *de la Quebrada*, or *Guayco de Santiago*, which are almost all *Allum*.

CHAP. 6.

Of Copperas.

THe *Copperas* is a Mineral substance very like unto *Allum*, and oftentimes they are found incorporated together.

The manner of separating them, is to put the leigh that is drawn off from the Stone or Earth, which contains the Mineral, into boiling Urine, and the Copperas will divide from the Allum, and fall to the bottom, the Allum remaining

maining ſwiming on the top. The Copperas is ſharp and biting to the taſte, and of an aſtringent quality; for which reaſon divers doe attribute unto it the properties of Sulphur, Iron, and Copper; the vertue of Allum, the ſubtilneſs of Saltpeter, and the drineſs of Salt.

Some Alchimiſts have written, as if the hidden vertues of the Philoſophers Stone were contained in this Mineral, whoſe Latin name is (*Vitriolum*) and they form a ſaying to that purpoſe, beginning every word with one of the letters of it, *viz. Viſitabis Interiora Terræ, Rectificando, Invenies Lapidem Veram Medicinam. Raymundus* ſaith, that it is very near of kindred to Gold, and hath the ſame original and principle; and it may be that is the reaſon why ſome affirm, that it is a ſign of a Mine of Gold, although the experience in theſe Provinces doth not correſpond therewith. It is ordinarily found with Copper, and in great abundance with the Black mettal, which alſo participates much of it, and thence takes the ill

ill ſmell it hath in working.

It is a very fine ſort of Copperas which the *Spaniards* call *Copaquiras*; and the beſt and pureſt of all is that they call *Piedra Lipas*, from the Mine of it found in that Province, although a few years ago a very plentiful Mine of it hath been diſcovered in the Province of *Acatama*, which is of a greeniſh colour, and that of *Lipa* is blew. There is alſo whitiſh and yellow Copperas, which the Painters uſe; and different colours of it have cauſed ſeveral names to be given it: of this Mineral are thoſe the *Spaniards* call *Myſi Sori Calohitis*, and *Melanteria*.

There is diſpute enough about its temperament and qualities, as well as about that of Allum. Some not allowing it to be hot in the third degree, will yet allow it to be ſo in the fourth: and others on the contrary, are of the opinion of *Juan de Rupeciſſa*, (who I think follows *Raymundus*) that it is cold in the third degree.

It is admirable to ſee its effect in *Aqua-Fortis*, (in which all Mettals like Salt,

Salt, diſſolve and are turned into water) and an ocular demonſtration of the poſſibility of the tranſmutation of Mettals one into another; for with Copperas diſſolved in *Aqua-fortis*, (without any other artifice) Iron, Lead and Tin become fine Copper: and Silver will loſe of its value, and be turned into Copper alſo with a little help of another mettal very eaſie to be gotten.

By the force of a moſt violent heat they extract Oyl from the Copperas, which is called Vitriol, of wonderful vertue.

They make two ſorts of artificial Copperas, blew and green, of a mixture of Iron, Copper and Brimſton put in the fire together.

Hereafter ſhall be declared, how and what miſchief Copperas hath cauſed in the working of mettals, a thing hitherto not taken notice of.

CHAP.

CHAP. 7.

Of Salt.

SAlt is no leſs neceſſary than commonly known in the world. And that which is Mineral hath the ſame vertue as that which is made of the Sea-water, or of the waters of brackiſh Lakes or Springs. The only difference is, that the Mineral-Salt is more thick and ſolid, whence it comes to paſs to be more aſtringent, and not ſo eaſily diſſolved in water as the made Salt is.

The Provinces of the *Weſt-Indies* as much abound in Salt as they do in Mettals; and a piece of the Sea between the *Lipes* coagulated into Chriſtalline-Salt; as alſo the Salt-pits called *Garci Mendoca* are none of the moſt inconſiderable wonders of this new world: Thoſe Pits are called *Garci Mendoza*, for their bigneſs, becauſe they be forty leagues long, and (where narroweſt) ſixteen broad: and alſo becauſe that ſome-

ſometimes in the middle of that ſpace are diſcovered, as it were, Wells that have no bottom, and great over-grown Fiſhes are ſeen in them. It is very dangerous travelling over this ſpace of ground, for fear of loſing ones eye-ſight, becauſe the great gliſtering of the Sun-beams, upon that place of Chryſtal, puts out ones eyes, unleſs they be defended with black Tiffany. There is danger of life alſo in that journy; it having happened, that going over that place, the traveller and his horſe, and all have been ſwallowed up, leaving no manner of mark behind of either of them.

In the *Lipes*, four leagues from the Mines of *St. Chriſtopher de Achocolla*, there is a ſmall Lake upon the top of a little hill, in a Country they call *Tumaquiſa*; in the middle of which Lake the water boils, and leaps up, ſometimes more, ſometimes leſs; making a frightful noiſe. Out of curioſity I went to ſee it, and found the noiſe and motion of it ſo terrible, that with reaſon there be very few that dare come near the mouth

mouth thereof: the water is thick to that degree, that it looks more like dirt than water: there is one ſmall gutter where it runs over, and that water iſſued forth becomes red Salt, as it runs along in little channels. This is a mighty ſtrong Salt, and has twice the vertue of common Salt in the working of Mettals.

It hath alſo been found to be an excellent remedy for the Dyſentery; perchance it hath in it a mixture of the red Allum, that gives it both colour and ſpirit. Hard by this Lake runs a vein of *Piedra Judaica*; and the Country thereabouts is full of mines of Copper.

A league and a half from *Julloma*, in the Province of *Pacages*, there be many Salt Springs, that as they guſh out of the ground, in a ſhort time become pure white Salt, (without the help of any art) and they encreaſe into heaps of Salt, until the winter rains diſſolve and ſweep them away. In the ſame Province near unto *Caquingora*, there be more Salt-Pits like unto the former; and

and the like there is in ſeveral other places. In theſe parts alſo is found in great abundance of the Mine or Rock-Salt, which is maſſy and tranſparent; looking like the pureſt Chriſtal. *Jullo-ma* hath in it plentiful veins of this kind of Salt. Many years ago the Inhabitants of *Curagnara de Carangas* have enriched themſelves by digging of Rock-Salt; and of later years they have diſcovered veins of it near the River of *Langa Collo*; but the Salt-mines of *Yocalla* (which God hath created near unto the rich mountain and City of *Potoſi*, that nothing might be wanting that was neceſſary for the working of its Oar) yields ſuch abundance of Salt as is incredible; whereof is daily ſpent in the melting of Mettals at the leaſt 1500 Quintales, and this conſumption hath laſted for many years.

Beſides the common vertues of Salt, which every body knows, *Arnaldo de Villa nova* (in his Treatiſe for the preſerving of youthfulneſs) ſays, that Rock-Salt is beyond any thing in the world for that purpoſe: He calls it the Mineral

Mineral *Elixir*, and preſcribes, that it be prepared with things that do not weaken it, or alter its properties; but he does not name the ingredients, nor the manner of doing it. *Juan Beguino* in his *Tyrocinio Chymico* teaches how to extract Oyl out of it of an extraordinary great vertue; and he ſays, that whatſoever is preſerved in that liquor ſhall be kept from putrefaction for many ages: and he believes that this was it that preſerved the body of the beautiful maid, (which *Rafael Volaterano* ſpeaks of) that was found in the time of Pope *Alexander* the Sixth, in an ancient tomb ſo freſh, as if ſhe had but juſt newly died, when as it appeared by the Epitaph, that ſhe had been buried there 1500 years before.

CHAP.

CHAP. 8.

Of Salt Ammoniac, and other Salts.

AMong all the Salts that Nature alone produceth the ſcarceſt, but of greateſt vertue, is the Salt-Ammoniac; they call it vulgarly Armoniac, and from that name conclude, that it comes from *Armenia*, but that is not the true name of it, but Ammoniac, which in Greek ſignifies, Salt of the ſand: and underneath the ſand (of the Sea-ſhore, I ſuppoſe) it is found congealed in little pieces by its internal heat, and the continual burning of the Sun, baked ſo much, that it is made the bittereſt to taſte of all kind of Salt. Goldſmiths uſe it more than the Phyſicians. It is one of thoſe they call the four ſpirits, becauſe the fire will convert them into ſmoak, and ſo they fly away: the other three are,

1. Quickſilver,
2. Sulphur,
3. Saltpeter.

It hath a particular property to cleanſe aud colour Gold, and is put into the compoſition of that *Aqua-fortis* that diſſolves it.

At this day we have little knowledge of the true Nitre, which was anciently made of the water of the river *Nilus*; although *Albertus Magnus* ſaith, that in *Goſelaria* there was a mountain that contained a very rich Mine of Copper; and the water that iſſued out at the bottom of it, being dried, became Nitre. We know little alſo of *Aphonitro*, which is but as it were the froth of Nitre.

Borax (which is called by the *Spaniards Chryſolica* and *Atincar*) is an artificial ſort of Nitre, made of Urines ſtirred togethet in the heat of the Sun, in a Copper Pan, with a Ladle of the ſame, until it thicken and coagulate, although others make it of Salt-Ammoniac and Allum.

Nitre is bitterer than Salt, but leſs Salt. Saltpeter is the mean between them two, and conſiſts of very dry and ſubtile parts, it grows in the walls of old Houſes, and in Stables, Cow houſes,

ſes, Hog-ſties, and Dove-coats: it will grow again in the ſame Earth it was taken out of, if that Earth, be throwen in heaps and ſpared, and taken care of; or if ordinary Earth be caſt up into heaps, and watered with brackiſh water, after ſome years it will give a great encreaſe, as profitable as crops of Grain.

The uſe of it in making of Gunpowder and *Aqua-fortis* is very well known. It is uſed alſo in the melting of Mettals, as ſhall be ſhewn hereafter.

CHAP. 9.

Of Juices, which the Spaniards *call Betunes.*

THe Betune is one of the things that does moſt damage of all unto Mettals, eſpecially in the melting of them, becauſe it burns them, and makes them become droſs, if they be not cleared of the Betune before they be put into a fierce fire: There be twelve ſorts of Betune,

viz.
- *Asphalto*,
- *Pissasphalto*,
- *Naptal la Piedra*,
- *Gagete*,
- *Azabache*,
- *Ampelites*,
- *Maltha*,
- *Piedra Thracia*,
- *Carbones de Mina*
- *Ambar de Cuentas*
- *Ambar Oloroſa*,
- *Alcanfor*.

But few of theſe ſorts are found mixed with Metals.

All Betunes are the oylineſs or fat of the Earth; and although ſome are of opinion, that *Alcanphor* is the weeping or Gum of the Tree *Capar*, in the Iſland of *Zebat*, and the Amber of another Hearb called *Polco*, (in *Spaniſh*) whereunto it is commonly found ſticking. And to the ſmelling Amber they aſcribe for its original a great Fiſh in the Sea like a Whale, becauſe there is great reſemblance between it and *ſperma Ceti*. Nevertheleſs that doth not hinder, that ſuch ſubſtances alſo may like ſweat, as it were, iſſue forth of the Earth; and make theſe Juices called Betunes.

Aſphalto is found in the Lake of *Sodom* (or the dead Sea) in *Judea*, whereinto runneth the river *Jordan*, three leagues

leagues from the City of *Jericho*. It is nothing elſe but an oyly froth that ſwims on the ſurface of the water of that Lake, agitated and driven by the winds and waves a-ſhore, and there condenſes and hardens. It is like unto Pitch, but harder, and of a better colour. Before God overthrew thoſe wicked Cities of *Sodom*, *Gomorrha*, *Admah* and *Seboim*, that fertile valley had little of this Betune in it, as may be collected from *Gen.* Chap. 14.

Theſe are found alſo in many other places and Provinces, ſome whereof uſe them to make Candles with, inſtead of Oyl; and although in *Peru* they have not been curious in further ſearch then how beſt to work their Oar of Gold and Silver, yet by the plenty of them that the *Indians* bring, it is known that there are of them in the *Cordillera de la Chiriguanes*, in the frontiers of *Lomnia*, although they have little acceſs to them, becauſe they be in the power of the *Indians*, that maintain war againſt the *Spaniard*.

The *Piſſaſphalto* is a natural compo-

ſition of *Aſphalto* and *Paz*, and ſo the colour of it declares; and for want of the true natural *Piſſaſphalto*, they counterfeit it of thoſe two materials.

La Napthe is a ſulphurous liquor, ſometimes white, and ſometimes black alſo, and is that which is called Oyl of *Peter*, of admirable vertue to cure old pains, proceeding from cold cauſes: It will draw fire to it (as the Loadſtone does Iron) with that force, that it will take fire at a great diſtance from the flame, as hath been confirmed by the miſerable experience of the *Conde de Hercules de Icontrarii*, of the Country of *Ferara*, who having a Well in his ground, the water whereof was mixed with *Petreol*; and by ſome breaches or cracks in the Well, much of this water ran to waſte; commanded it to be repaired; the Laborer that was let down into the bottom of the Well deſired a Candle, the better to ſee his work, which was furniſhed him in a Lanthorn, and immediately through the holes of the Lanthorn the *Napthe* ſuckt the flame into it ſelf, and ſet fire on the whole

whole Well, which diſcharged it ſelf inſtantly like a great piece of Cannon, and blew the poor man into pieces, and took off an arm of a Tree that hung over the Well. The *Conde* himſelf told the ſtory to *Matiolo*, who reports it in his *Dioſcorides*.

Aſphalto and *Piſſaſphalto* melt in the fire as Pitch or Wax, and by that they are diſtinguiſhed from the *Piedra Gagate*, or *Aſcabache*, and alſo from Pit-coal, which burns and conſumes it ſelf away like Tea, or any other ſort of wood. As yet I have not heard whether there be any Betunes in theſe Provinces, although I perſwade my ſelf there be, if they were ſought for.

CHAP. 10.

Of Sulphur and Antimony.

SUlphur is a Mineral the moſt univerſally known of any. It is made of an Earthy unctuous ſubſtance, and very hot, to that degree, that it is

eſteemed to be neareſt of kin to the Element of fire, of any compounded ſubſtance. The Chymiſts call it, the Maſculine ſeed, and Natures firſt agent in all generation: and they ſay, that the difference between one thing and another, ariſes from the divers preparations and mixtures of Sulphur and Quickſilver. It hath happened to an Apothecary, that going about to make a ſalve compounded of thoſe two materials; he has found the reſult to be a Plate of fine ſilver. After many conſiderations of this ſubſtance, *Thophraſtus Paracelſus* proceeds to contemplate the wonders produced by Sulphur, and ſaith, that God by an eſpecial providence hath concealed thoſe myſteries; and that it is an evident confutation of thoſe, who oppoſe the tranſmutation of Mettals; for this Mineral doth effect it: and he teaches a way to make an Oyl, called in *Spaniſh* (*Epatica Sulphuris*) which turns Silver into Gold. And *Heliana*, the Author of a book, called (*La Diſquiſition*) teaches the ſame thing with raw Sulphur, to ſhew the

the poſſibility of it, although it be in very little quantity. The ſmoke of it helps to fix the Quickſilver, and turn it into Plate, whereof there be many eye-witneſſes in theſe Provinces. And this Sulphur diſtilled in a Glaſs-Still, makes the Oyl of Sulphur, of ſuch rare and admirable vertue, eſpecially for the French Pox, taking three or four drops thereof every morning for a week together in ſome liquor proper to convey it in. It is good to cure the difficulty of Urine, and the pains of the Gout, and many other things, as you may ſee in *Diodorus Euchiente*, and divers other authors. There is abundance of Brimſton in the Province of the *Lipes*, and in the confines of the *Pacages*, and in *la Puna de Tacora*, or *los Altos de Arica*, and in many other parts beſides, it's found incorporated with Mettals in the richeſt Mines of *Peru*.

The Antimony, or *Stibium*, which ſome Miners call by the name of *Alcahole*; and others (particularly in *Oruro*) call it *Macacote*; 'tis a Mineral very like unto that they call *Sorocha*, or Lead,

Lead, that is very porous; it ſhines very much, and is brittle; ſome of it is of a reddiſh yellow colour, and ſome there is more inclining to white, and very finely grained, as Steel ſhews where it is broken.

It is made of a very corrupt, and imperfect mixture of Brimſton and Quickſilver, and ſeems to be an abortion of Nature, and the *Embrio*, which would become mettal, if it was not taken out before its time.

Porta Vegino, and others do teach a way to draw out of this a kind of Quickſilver, which they call *Regalo*; but it is inclining to red, and has not ſo lively a motion, as the ordinary Quickſilver. By *Aqua-fortis* alſo Brimſton (whereof it is compounded) is gotten from it in its proper form of a green colour, and burns as ordinary Brimſton does.

Baſillius Valentinus in his Triumphal Chariot of Antimony, having ſpoken of many of its excellencies, afterwards teaches how to make of it a Fire-ſtone, (as he calls it) which will turn other mettals

mettals into Gold. *Paracelſus* writes much alſo to the ſame effect; and other Chymiſts with a continued voice do ſpeak of an oyl, which is gotten from Antimony for the ſame purpoſe: but from a more certain and neceſſary experience does *Matiolus* commend his ointmet, for the curing of old Ulcers, and for other medicinal uſes.

Stibium has a drying and aſtringent vertue, and the preparation (which theyc all) *Hiacint* is held to be a very ſtrong purge, and a provoker to vomit. This *Alcahol* is very commonly found comprehended in the Silver-Oar, and particularly in that which in *Peru* is called the black Oar; nevertheleſs in many parts it is found in a body by its ſelf. It does a great deal of miſchif in the working of Mettals, as the Betune and Brimſton does, and therefore muſt carefully be gotten out before-hand, as ſhall be ſhewed hereafter.

CHAP.

CHAP. II.

Of Marcaſita, Orpiment, and Sandaraca.

Marcaſita is alſo called *Pyrites*, which ſignifie a ſtone of fire, becauſe being ſtruck with Steel, it yieldeth fire in greater abundance, than any other Mineral: ſome will have it to be begotten of an undigeſted vapor, others that it is compoſed of a courſer ſort of Brimſtone, or Betune, and ſtone; it grows in all ſorts of Mines, but eſpecially where there is Copper, and the black Silver Oar, whereof it doth much participate, and perhaps that is the reaſon, why *Dioſcorides* ſaith, that the *Marcaſita* is a kind of Copper: and notwithſtanding *Albertus* and others do think the *Marcaſita* contains no Mettal in it; yet experience has taught the contrary; for the farmers of the Mines of *Monſerrat en los Chichas*, when they began to dig thoſe Veins, they found the Oar to contain

as

as much Silver as it did of *Marcaſita*: and in this mountain of *Potoſi*, and others, there is a fine ſort of this *Marcaſita*, which is found incorporated with the black Silver Oar, and is a certain ſign of its richneſs; there be as many kinds of *Marcaſitas*, as there are of Mettals, whoſe colours they repreſent; the moſt common ſort looks like Gold; being put in the fire, it ſmells like Brimſton, and flames much, which is a ſign it is compounded, as has been ſaid before.

Gold, Silver, and Copper are uſually found contained in it: it is a great hinderance to the melting that Oar where it is incorporated, dividing the Quickſilver into very ſmall particles, as ſhall be ſhewed hereafter, together with the proper remedies for it.

Orpiment and *Sandaraca* are of the ſame nature, and vertue, and are only made to differ by their greater or leſſer concoction in the bowels of the Earth. *Sandaraca* being nothing elſe, but *Orpiment* well concocted, and by conſequence thereof, heightned in vertue,

as

as is demonſtrated by putting *Orpiment* into a Fining-pot, and ſetting it on the fire, whereby after a convenient concoction, it will become red, and of as lively a colour, as the moſt perfect natural *Sandaraca*. Where *Orpiment* is found, it is a certain ſign of a Mine of Gold, wheref alſo it always contains ſome ſeed or little particle; as *Pliny* reports, in the time of the Emperor *Caligula*, that he did then extract ſome Gold out of it: ſince that time, it has not been attempted, becauſe the coſt does much exceed the benefit.

The beſt ſort of *Orpiment* is that, which is of a ſhining Gold colour, that is not faſt compacted, and eaſily breaks into ſcales, (as it were) the moſt perfect *Sandaraca* is that which is reddeſt, pureſt, and the moſt brittle, of the colour of *Cinabrio*, (an *Indian* word, of a Gold colour) and it hath a ſtrong ſmell of Sulphur, whereby, as alſo by its other qualities, and medicinal vertues it is diſtinguiſhed from *Sandix*, which is of the ſame colour, and is made of *Albayalde* well burnt in the fire,

which

which ſome alſo improperly call *Sandaraca*; theſe are poyſon, by reaſon of their ſtrong corroding, and burning quality, not only upon the bodies of Animals, but upon Mettals alſo, in like manner as antimony, or Brimſton, or other dry Minerals; for by reaſon of their oyly parts, they take fire, and being mingled with Mettal, they burn and conſume the moiſture thereof whereby the mettal moulders away, and is loſt: There be other Juices, that are ſcarcer, and not commonly known, as they report of one, that is found in the Mine of *Ancbergo*, which is white and hard, and poyſons the cattel that taſte it: and it maybe, of this kind was that vein which perſons of good credit have told me was found in the Province of *Conchucos*, in the Archbiſhoprick of *Lyma*, with which the inhabitants of that Country uſed to kill thoſe they had a mind to be rid of; to prevent which wicked practice, the holy Archbiſhop *de los Reyes*, *Don Soribio Alonſo de Magrobejo*, commanded the Mine to be ſtopt up.

CHAP.

CHAP. 12.

Of the Generation of Stones.

IT is moſt certain, that there is ſome very active principle or vertue that operates in the generation of Stones, as well as upon the reſt of the matter of the Univerſe, that is ſubject to generation and corruption; but the difficulty lies in knowing what that principle is, becauſe it operates in no determinate place, but ſometimes Stones are made in the air, in the clouds, in the earth, in the water, and in the bodies of Animals.

Avicena and *Albertus* think the matter, whereof Stones are made, to be a mixture of Earth and Water; and if the greater part be Water, it hath the name of liquor; but if the greater part of it be Earth, then it is called dirt or clay.

That clay which is fit to make Stones of, muſt be tough, and ſlimy, ſuch as Bricks,

Bricks, Pots, and other Earthen veſſels are made of; for if it be not ſuch, as ſoon as the fire hath conſumed the moiſture of the dirt, it will not hang together, but crumble into earth, and duſt: it is alſo neceſſary, that the liquor, which is to be converted into Stone be very ſlimy; the experience whereof we find in our own bodies; the Phyſicians being generally of an opinion, that the Stone is begotten in the reins and bladder of ſlimy tough humors, baked hard by the heat of the body: this opinion touching petrifying liquors, is confirmed paſt all queſtion, by the experiment of that famous water in this Kingdom of *Peru*, near unto *Guancavelica*; which they take and put into moulds of what form and bigneſs they pleaſe, and expoſe it to the Sun, for a few days, whereby it is made perfect Stone, and they build their houſes with it: all the cattel that drink it dye; and from what has been ſaid before, it is not hard to conjecture the reaſon.

In a mountain called *Pacocava*, a league from the Mines of *Verenguela de*

Pajages, there be Springs of this liquor, (the colour whereof is whitiſh, inclining to yellow) that as it runs along, condenſes into very hard and weighty Stone, of different ſhapes. Moreover any porous ſubſtance that can ſuck this kind of liquor into it, is apt to be turned into Stone; and of thoſe I have ſeen Trees, and Limbs and Bones of Beaſts turned into hard Stone. In the City *de Plata* I have ſeen ſticks of wood taken out of that great River, (of the ſame name) ſo much of which as had remained covered with the water, being converted into very fine Stone: I ſaw alſo the Teeth and Bones of Giants, that were dug up in *Tarija* turned into heavy and hard Stone.

Stones have their ſubſtantial forms, which makes them differ ſpecifically; yet becauſe we cannot come to the knowledge of them; in our definitions we are fain by way of Periphraſis to make uſe of accidents and properties. Every ſeveral form of the Stones is accompanied with particular vertues, as remarkable as thoſe of Animals or Plants,

Plants, and proportioned to the length of time Nature takes in its generation; but becauſe Plants and Animals are to have ſo different diſpoſitions, and to produce ſuch various and admirable effects, they cannot be of ſo uniform, and well mingled a temperament as the Stones are, nor is their ſoft and gentle ſubſtance capable to endure ſo much force; as neither is the hardneſs of the Stones fitted for the producing variety of ſeveral ſhapes, and therefore in them are found no leaves, flowers, fruits, hands nor feet, as in Plants and Animals, though they have a greater vertue of another kind.

CHAP. 13.

Of the Differences of Stones one from another.

ALL ſorts of Stones are reducible under ſome of theſe five following ſpecies.

1. If they be ſmall, very ſcarce, and

very hard of ſubſtance, and have luſtre, they be called precious Stones.

2. If they be of great magnitude, (although they be rare and have luſtre) they are ſome kind of Marble.

3. If in breaking they fall into ſplinters or ſcales, they are a ſort of Flints.

4. If they be of a ſmall grain, they be Pebles.

5. Thoſe that have none of the above-ſaid qualifications, are Rocks or ordinary Stones.

But the Miners for the better diſtinction of the ſorts of Stone, wherein Mettals are engendred, uſe peculiar names for them; for example, a kind of Stone like Peble, which contains Gold, Silver, or any orher Mettal they call *Guijos*, which breeds a richer vein of Mettal than any other Stone.

Cachi, another ſort of Stone white like Alablaſter, ſoft and eaſie to break in pieces, is all this Country called Salt. Much Lead is engendred in this kind of Stone, in the veins of (*Metales pacos*) which is the name the Miners here give unto their Silver Oar.

Chumpi

Chumpi (which is ſo called, becauſe it is of a grey colour) is a Stone of the kind of Eſmeril mixed with Iron; it ſhines a little, and is very hard to work, becauſe it reſiſts the fire much. It is found in *Potoſi* and *Chocaya*, and *other places*, with the black Mettals and *Roſicleres*.

Lamacrudria is that Stone which is cloſe compacted, and ſolid, and ſhews not the leaſt grain nor porouſneſs when you break it, and is of a yellow colour, and ſometimes high coloured, as blood-red.

Almaclaneta is the name they give another kind of Stone, which is very ſolid and weighty, of a dark colour, always found in the company of rich Mettals, which are engendred in it, when it comes to be corrupted and rotten; as in like manner is done in the *Gouijos*. It grows upon the Flints of the Gold Mines, and thoſe of Copper and Silver.

Amolaclera (or Whetſtone) is that ordinary Stone, which is commonly made uſe of for that purpoſe, and ſo

known to every body. Divers rich Mettals grow upon it, but moſt commonly (*los Cobriſcos.*)

The veins of Silver are rare and inconſiderable, that are found in Pitcoal; although it be a more proper bed for Gold.

Other Stones that grow in Mines, or cleave unto the Mettal, they call *Ciques*, (and alſo *Caxas*) which are rough and uneven, but not very hard, nor very ſpongy, and commonly have nothing of Mettal in them, although in ſome rich Mines they are infected with ſome little, by the vicinity of the Oar.

The Stones of *Potoſi*, called *Vilaciques*, have been, and are very famous, for the abundance of Silver gotten out of them; and are one of the ingredients that make this Province, without compariſon. *Vila* ſignifies blood, (in *Peru*) or any red thing; and for the ſtreaks of red this Stone hath in it, they call it *Vileciques.*

CHAP.

CHAP. 14.

Of Precious Stones.

PRecious Stones are either tranſparent, as the Diamant is, or obſcure, as the Onix, or between both, as the Sandonyx and the Jaſper. It is the water which is the principal cauſe of clearneſs, and the Earth of the opacity of them. So that the reaſon why they excel one the other in luſtre and tranſparency, is from the variety of humors congealed together to compoſe them, which are ſome of them more pure and clear than others.

White Stones are made of a humor almoſt like water, and ſo are more clear and tranſparent; ſuch is the Chriſtal, and the (*Iris*) ſo called, becauſe being held oppoſite to the Sun-beams, it much reſembles the Rainbow.

The Diamant is engendred of a leſs clear humor, than the Chriſtal or Iris, and ſo is more obſcure than either of them.

them. The ſame variety may be obſerved in all precious Stones of what colour ſoever they be; whether compoſed of Juices or humors that be green as the Emerald, and the Praſma, or of blew, as Saphir, the Caiano, and ſome ſort of Jaſper, or red, as the Ruby, or purple, as the Jacynth and Amatiſt, or Gold-colour, as the Chryſolites and Topaz, or of mingled colours, as the Opalos.

In like manner it is to be imagined, that the other ſorts of Stones that are not tranſparent, are engendred of a mixture of black and thick humors; an inſtance whereof we ſee in water, which though it be naturally white and clear, yet mingled with Ink or ſuch like liquor, it loſeth its tranſparency, though not the luſtre of its ſuperficies.

The different colours of the juices or humors aforeſaid, ariſes from the various mixture of black and white matter, whereof the Stones are engendred: Although *Raymundus* and many others attribute it more immediately to the variety of Mettals, of whoſe pureſt liquors

liquors precious Stones are engendred, in the heart of other hard Stones, whither that liquor hath penetrated, and thereby much refined it ſelf. And that in eſtimation, precious Stones hold in proportion to the Mettals of which they are engendred, as the Ruby to Gold, the Diamant to Silver, the Emerald to Copper, and the reſt in like manner. In his *Compendium* of Tranſmutation, dedicated to *Robert* King of *England*, he doth particularly teach the way of making artificial precious Stones (by a mixture of the waters of divers Mettals) as beautiful, and of the ſame vertue as the natural ones are. A knowledge (over and above other excellent qualities of that rare perſon) which ſeems to outgo humane capacity. But it is the eaſier to be believed, becauſe we ſee Eſmalts made of divers colours, by a compoſition of Minerals ground to powder and glaſs, and falſe Stones made in the ſame manner.

Tranſparent precious Stones have many faults in them, which by reaſon of their clearneſs are ſooner diſcovered by

by the eye, than thoſe in common Stones; as ſpots appear the moſt in the fineſt garments; and it is rare to find a Stone that hath not ſome defect or other; either ſpots, or hair, cloud, ſhadow, ſalt, or other thing ſubject to be engendred in them, becauſe the humor of which it is made is not all of one colour. A ſhadow ariſes from the humors being more obſcure in that part. A cloud coms from the humors being too white in that part. Hairs, which are ofteneſt found in the Saphir: and ſalt which particularly hurts the Opalos, as Lead doth the Emerald, are impediments of different colours from the true colour of the Stone in which they are.

CHAP.

CHAP. 15.

Whether there be precious Stones in the Kingdome of Peru.

HItherto the induſtry of the people of theſe Provinces hath been principally applied in the ſearch after Gold and Silver, and they have neglected the enquiry after precious Stones, although there have been and are many notable indications, that this flouriſhing Kingdom wants not this prerogative alſo.

there is a conſtant report, and I my ſelf have heard it in the Country of the *Lipes*, that in the adjoyning Province of *Atacama*, there have been found excellent Diamonds; and that in exchange for a little *Cocus*, worth not above two Reals, an *Indian* old woman ſold a handful of rough Diamonds, which in *Spain* were worth many Ducats. It is a Country full of beautiful Stones to ſee to, and therefore may very well be ſuppoſed to have riches in it.

There

There be ſtore of Amatiſts in a wood called by that name, which ſtands hard by the Mines of *Eſmeruco*. And in the rich Mine of St. *Elizabeth* of new *Potoſi*, there be found rich and well grown Amatiſts among the Silver Oar. There are of the ſame kind of precious Stones in *Paraguay* and *Buenos Ayres*; they are engendred in (*Papas Lanadas*) one or two fathom under ground, in a very hard and heavy Flint Stone, which they call a *Coco*, becauſe like the Coco-nut; it is about the bigneſs of ones head. The Amatiſt within will be as big about as two fingers, naturally coagulated into ſhapes like fine lace, and is more or leſs mature and perfect, according to the condition it was in when the Coco burſt, which it doth of its own accord, and then makes a report like a piece of Ordinance, and makes the Earth near it tremble for a good while; and that juſt over it to break and open; by which tokens men go to the place, and dig for the Coco, which they find ſplit into two or three or more pieces. This is a thing well known, and common in theſe

theſe parts of the world. Near unto the place called *Aqua Caliente*, (for the hot water that there guſhes out) in the way between *Potoſi* and the *Lipes*, there is a (*Pampa*) full of a pure tranſparent Chryſtalline Stone, formed by nature into ſeveral angles that meet in one point: I always pickt up ſome of them when I went that way; admiring their beauty; for expoſing them to the Sun-beams, they looked all like ſo many ſeveral Suns. The largeſt that I ſaw of them was about the bigneſs of ones Thumb.

Of this ſort, although much ſmaller, yet there be abundance in the Countries of *Callapa* and *Julloma*: in the Province of *Pacages* I gathered ſome alſo naturally cut like Roſe-Diamonds, as big as large Peaſe; and waſhing the ſand, I often obſerved amongſt it little ſmall points of the colour of Gold, and tranſparent, like unto the beſt Topaz; and others of that ſort as big as Barley-corns, which if they were bigger, would be of great eſteem, and no doubt but ſuch might be found, if hearty induſtry

duſtry were employed thereabout.

The Stones of the Mine of *Camata*, in the Province of *Larecaxa*, do vi in beauty with the Diamond, and are worn in Bracelets and Rings in this Kingdom.

In the great Head land of *Arica*, between the Rocks within the Port, there is a Mine, whence they get Stones tranſparent as Diamonds, and very near as hard, whereof alſo they make Jewels.

The beſt Turqueyes are found in *Atacama*: I have ſeen one in the *Lipes*, as big as a twelve-pence *Engliſh*. The *Indians* of this Country eſteem it great bravery to have Necklaces and Bracelets of ſmall Turqueyes curiouſly compoſed. The men wear great ones of this kind about their necks, like Gold chains. They wear ſuch chains alſo of green Stones; and the officers of their Armies eſteem them moſt of all, and account them the beſt ranſom a priſoner can give them.

Pearls alſo are gotten in the coaſts of *Atacama*, and in the *Mexillones*, which

are

are taken out of Oyſters, and brought hither to ſell: it is very ordinary to find Pearls in the dreſſing or eating of the Oyſters.

I have little knowledge of the fertility of the lower Countries in theſe kinds, becauſe they have little or no commerce here. Beſides my chief intention is to give your Lordſhip information of the Mines of the Provinces ſubject to your own Juriſdiction, and that I have ſeen in perſon. Nevertheleſs at the time of the firſt Conqueſt of theſe Countries, there were found many and very large Emeralds in the hands of the Natives, as appears by the Hiſtories thereof.

CHAP. 16.

Of other ſorts of Stones.

IT doth very little import the owners of Mines (for whoſe ſake principally, by your Lordſhips command, I have written this Treatiſe) to diſcourſe more

more particularly of other Stones, although the common ſort of Stones, becauſe they are ſo, are little enquired into or underſtood; and when in Mines they meet with ſome Stones of rare colour and tranſparency: their beauty would invite the Miners eſteem, if the covetouſneſs after Gold and Silver, which they ſeek for, did not blind their eyes and underſtandings, ſo that they cannot attend to look after them. But becauſe I have given an account of all Minerals together; and that Marbles are of next eſtimation unto precious Stones: it is but juſtice to treat a little of thoſe Marbles we find in theſe Provinces, which I believe equal to any that we read of in ſtory.

The Province of *Atacama* above all others beſt deſerves to be curiouſly enquired into, by able and experienced Artiſts; for it produces Stones of ſuch various colours, and beautiful gloſs, and luſtre, that only the great quantity, and abundance of them hinders them from being reckoned among the precious Stones.

This

This whole Kingdom is full of curious Altars made of theſe Stones; and very many of them have been carried into *Europe*; and they have not been wrought for any other purpoſes; yet either for want of Stone-cutters to work them, or becauſe moſt of us in theſe parts have in our eye to return home again into *Spain* with great eſtates, and care not for perpetuating our fame in theſe parts, by ſumptuous buildings; for which theſe ſort of Stones were very fit materials.

There is a Stone in this Imperiality, worthy for its variety, luſtre, and greatneſs, to be preſented to the view of the King our Sovereign Lord. It is ſix Palmes in length, and one Palme ſix Inches leſs in breadth, and two fingers thick: it is in form like a Planck or large Table; it is full of delicate clouds, made by the compoſition of its colours: there be ſome red, and ſhining tranſparently, others more obſcure, as black, yellow, green and white: upon the blackeſt ſpot in all the Stone is reſembled ſnow, as it were fal-

ling upon it, or milk, according as the white happens to be mixed with ſhadow.

In the Mines of *Verenguela de Pacagues*, there be other Stones, not inferior in the nobleneſs of their ſubſtance and luſtre, to thoſe of *Atacama*, although they have not that variety of colours. They be white as Alablaſter, and tranſparent; and becauſe that colour is not equally diſtributed, it cauſeth, as it were, clouds, which gives much gracefulneſs and beauty to the Stone: no liquor will ſink into them, they be ſo hard, like unto natural Chriſtal. The Font in the Church of *Fulloma* is a very large one, and yet is made of one of theſe Stones. And though it be ſix fingers in thickneſs, yet you may ſee plainly through the ſides of it the light of a Candle ſtuck up in the middle. In the Jeſuits colledge, at the City of *Paz*, there is a famous Water-pot of this Stone, through whoſe ſides you may ſee the water riſe as it is poured in, juſt as if it were through tranſparent Glaſs.

CHAP.

CHAP. 17.

Of ſome accidents happening to Stones, and the Cauſes of them.

BEſides ſhining and tranſparency, which as hath been ſaid, is found in divers Stones, and in the common ſort of Stones is not found; there be alſo other accidents that accompany them, *viz.* Hardneſs and Softneſs.

Hardneſs is ſo eſſential to all precious Stones, that they be not held for ſuch, upon whom the File will make any impreſſion. If the matter of which the Stone is compounded be tough, and dried by a violent fire, till the moiſture be conſumed, it cauſeth hardneſs, becauſe it contracts and condenſes the matter within it ſelf. If the matter have little or no toughneſs, then the moiſture being eaſily dried away by heat, and the earthy part burnt, there will remain a Stone ſoft and brittle, Alſo the Ambient cold will condenſe

matter and make it hard, as we ſee in Stones congealed thereby, the which will diſſolve again by the fire, and the congealed humor relax and run: Stones that want moiſture enough to glue their terreſtrial parts together, when they be put into the fire they break into ſmall pieces: and thoſe which are drieſt of all do reſolve into duſt or lime by the fire.

Some Stones are porous, others maſſy and well put together. The firſt ariſes from the unequal and ill mixture of the wet and dry parts whereof it is compounded, ſo that the heat exhaling the moiſture, where no earthy ſubſtance was mingled with it, leaves a hollow place, or pores, which make ſpongy Stones. As for the oppoſite reaſon, we ſee the contrary effect in maſſy Stones. Stones are found of various figures, and cauſing as much admiration as moſt things in nature. Perchance it may come from the various mixture, colours, and veins of Stones; as you may ſee in their clouds and ſpots repreſented towers, ſheep, and other

Animals

Animals and figures. And in Lead poured out upon water, often happens the like. The ſtory is famous of the Agates of King *Pirrhus*, that repreſented *Apollo* and the nine Muſes as lively as the beſt Painter could draw them: and *Cardanus* ſays, he had one of that kind that was a true and exact picture of the Emperor *Galba*.

They ſay, that in the houſe of *Wiſdom* at *Conſtantinople*, there is a Marble Stone, that by the very natural veins of the Stone, hath the picture of St. *John* the *Baptiſt*, with his cloathing of Camels skin expreſſed to the life, excepting one of his feet, which is imperfect.

It is a ſign that nature hath not wrought by chance, but by particular ſtudy, and to ſome myſterious end, when in the ſame ſpecies of Stones are found the ſame marks and figures, like thoſe in the fields of *Verona*, which *Leon Baptiſta* reports to have ſeen; and that they have painted upon them the image of the Chair of *Solomon*. And another black Stone, which being broken at one end, hath painted in it exactly, and

to the life, the picture of a Serpent; and that it hath the vertue to draw Serpents unto it. *Albertus Magnus* affirms to have ſeen 500 Serpents gotten upon a Stone of that kind, which was preſented unto him.

When we meet with Stones, that repreſent Animals, or the limbs of them, or Plants, or other things not by ſuperficial draught or colouring, but in bulk and ſubſtance: I believe it may ariſe from ſome petrifying liquor, which that matter has ſucked into its pores, and thereby is become all Stone, and ſo thinks *Avicene*: but although ſometimes this may be the cauſe thereof, yet methinks it cannot reaſonably be ſuppoſed to be ſo always.

At the foot of the Mountains *Miſnenſes*, near unto the Lake of *Alſacia*, Stones are very commonly found that have emboſſed upon their ſuperficies, the images of Frogs and Fiſhes in fine Copper. Anciently they called a ſort of Stone *Conchites*, which were in all their lineaments very like unto the Cockles of the Sea; and they thought that

that thoſe fiſh ſhells lying a long time in ſoil, where much Stones were begotten, the petrifying liquor entring into the pores of the ſhell converted it into Stone: and they ground this opinion upon the certainty that the Sea in old time hath overflown the whole Territory of the City of *Magara*, where only theſe ſort of Stones are found. But of later times all colour of reaſon is taken away from the forementioned conceit, by the wonderful veins of Stone, ſome grey, ſome Iron coloured, and ſome yellow, which are found in the high way, as one goes from *Potoſi* to *Oroneſta* down the Hill. There they gather Stones that have in them impreſſions of divers ſorts of figures, ſo much to the life, that nothing but the author of nature it ſelf could poſſibly have produced ſuch a piece of workmanſhip. I have ſome of theſe Stones by me, in which you may ſee Cockles of all ſorts, great, middle-ſized, and ſmall ones. Some of them lying upwards, and ſome downwards, with the ſmalleſt lineaments of thoſe ſhells drawn in great perfection;

and this place is in the heart of all the Country, and the moſt double mountainous land therein, where it were madneſs to imagine that ever the Sea had prevailed, and left Cockles only in this one part of it. There be alſo amongſt theſe Stones the perfect reſemblance of Toads and Butterflies, and ſtranger figurs, which though I have heard from credible witneſſes, yet I forbear to mention, and not to over-burden the belief of the Reader. Over-againſt this wonderful vein of land, on the other ſide of the valley of *Oroncota*, ſtands that famous piece of land they call *Pucara*, (which ſignifies in their language, fortreſs) it is a place the beſt fortified by nature of any now known in the world, being ſituate very high, ſeven leagues in compaſs, and all ſurrounded with high and inacceſſible hills, only on the one ſide there is a ſmall avenue after having paſt a very difficult aſcent. In its ſpacious fields, on the top, there be many fine brooks of water, wood, paſture-ground, commons and waſtes, very commodious for the ſupport of humane life. CHAP.

CHAP. 18.

Of the Generation of Mettals.

IT is no wonder, that learned men differ ſo much in their opinions, about the matter whereof Mettals are engendred, becauſe the Author of Nature ſeems to have created them in that obſcurity, and depth, and to have immured them with hard Rocks, on purpoſe, to hide their cauſes, and to give check to the ambition of Man.

The Philoſophers, who pretend to know the cauſes of things, beſides the firſt matter, (which is the firſt principle, not only of Mettals, but of all other bodies in the world) aſſign another matter remote alſo, which is a certain moiſt and unctuous exhalation, together with a portion of thick and tough Earth, from which, being mingled together, there reſults a matter, whereof not only Mettals, but alſo Stones are made: for if the drineſs prevail,

vail, Stones are begotten, but if the unctuous humidity be predominant, then Mettals are begotten; *Plato*, *Aristotle*, and their followers are of this opinion.

From the abundance of this pure, and ſhining moiſture; made ſolid, proceeds the luſtre of Mettals, in whom, of all the Elements, water is experimentally known, to be moſt predominant, and therefore they run, and are diſſolved by the fire.

From the various temperament, and purity of the aforeſaid matter, comes the divers kinds of Mettals, the moſt pure and fine of all which, and (as it would ſeem) Nature's principal intention, is Gold.

Many, to avoid difficult diſputes of this nature, do hold with the vulgar; that at the Creation of the world God Almighty made the veins of Mettals in the ſame condition, as we now find them at this day; herein doing nature a great affront, by denying her (without reaſon) a productive vertue in this matter, which is allowed unto her in all other

other ſublunary things; moreover, that experience in divers places hath manifeſted the contrary: A clear example whereof we have in *Ilva*, an Iſland adjoyning unto *Tuſcany*, full of Iron Mines, which when they have dug as hollow, and as deep as they can, the circumjacent Earth falls in, and fills them up again; and in the ſpace of ten or fifteen years at moſt, they work thoſe Mines again, and thence draw out abundance of Mettal, which that new Earth hath been converted into: many do think that the ſame happens in the rich hill of *Potoſi*; at the leaſt all of us know, that the Stones, which divers years ago we have left behind us, thinking there was not Plate enough in them to make it worth our labour, we now bring home, and find abundance of Plate in them, which can be attributed to nothing, but to the perpetual generation of Silver.

The Alchymiſts (a name grown odious by reaſon of the multitude of ignorant pretenders to that Art) with more profound and practical Philoſophy have anato-

anatomized the mixtures of nature, and reduced them from their firſt principles; and concerning the matter of Mettals, do diſcourſe in the manner following: The Sun (ſay they) and all the Stars with their light, proper, or borrowed, continually going round the Earth, doth heat the ſame, and with their ſubtil Rays, penetrate through its veins; and we ſee things long burnt in the fire are converted into other terene ſubſtances, as Wood and Stones into Lime and Aſhes: ſo in like manner this Earth calcined by the Celeſtial bodies, mingled and boiled with water, changes it ſelf into another kind of ſpecies, that contains in it ſelf ſomething of the ſubſtance of Salt and Allum; every day we ſee the ſame effects in the lees made of Lime, Aſhes, Sweat and Urine, all which by boiling, get the taſte of Salt. This firſt matter, or foundation of the generation of Mettals is Vitriol, which is eaſier to believe, ſince we ſee that all of them by art, may be reduced thereunto, and the manner of reducing ſome of them ſhall be declared hereafter.

This

This Vitriol by the heat of ſubterranean fire, and attraction of the heavenly, ſends forth two fumes or vapors; the one earthy, ſubtil, and unctuous, and ſomething digeſted, which the Philoſophers call Sulphur, becauſe it hath the qualities thereof: the other vapor is moiſt, wateriſh, ſlimy, and mingled with very fine Earth; and this is the next matter, whereof Quickſilver is made. If theſe two vaporous exhalations do find a free and wide paſſage out of the Earth, then being carried up into the Region of the Air, they are converted into Comets, Clouds, Snow, Hail, Thunder, and other things that appear there.

But if the aforeſaid exhalations chance to be included between hard Rocks, in ſtrait and narrow places, whence it cannot get out, or the place be already full of Minerals, the ſaid vapours will thicken, and be turned into thoſe they call half Minerals.

If theſe fumes penetrating the Rocks, do not meet with a kind of clarified Brimſton, that ſhines like Silver, and is ſome-

ſomething like unto the Fire-ſtone, which the *Spaniards* call *Marcaſita*, (without which no Mettal can be engendred) they will ſtain the Rocks with ſeveral ſorts of colours, if theſe vapors aſcending, and endeavouring to get out meet with any Stones ſo hard, as they cannot penetrate them, then they are converted into perpetual Springs of water; the like effect whereof we ſee in every common Still; but if when they paſs through the Rocks they meet with, thoſe two Juices, namely the Fire-ſtone, or Brimſtone clarified and conſolidated, as hath been ſaid a little before, then it diſſolves the ſaid Juices, mixing it ſelf with them, and after boiling together a convenient time, it thickens and hardens in the Mine; this is the Doctrine of *Braceſco* in his comment upon *Getro*; but the greateſt number of Alchymiſts do affirm the immediate matter of Mettals to be Quickſilver and Sulphur, and that from the different proportion of their mixture, and greater or leſſer purification, reſults the differnce that is found in Mettals.

CHAP.

CHAP. 19.

The Opinion that Quickſilver and Sulphur are the matter whereof Mettals are made, is defended.

THoſe that think nothing can be effected that comes not within the compaſs of their own capacity, a preſumption very unworthy of learned men, and much diminiſhing their credit (who are poſſeſſed therewith) from reaſons that neither convince nor are of any force to deny, hold, that it is not poſſible by art to change one ſort of Mettal into another. It is not proper in this place to examine all the arguments of that kind, although the great connexion they have with the right knowledge of Mettals, whereof we treat, makes it neceſſary to handle ſome of them, and to make the weakneſs of their foundation plainly to appear.

They ſay, that the Alchymiſts are ignorant of the manner whereby Nature

ture Creates and brings Mettals to perfection; and that it is erronious to say they are compounded of Quickſilver and Brimſton, becauſe if it were ſo, there would be found in the Mines of Gold and Silver, and of other Mettals ſeveral indications and pieces of thoſe Juices; whereas common experience ſhews the contrary; for anſwer thereunto, the firſt part of that reaſon imports little; for though it be granted, it infers no more, but that thoſe Alchymiſts that went about thoſe tranſmutations, proceeded mechanically, and without good knowledge in the art; but nevertheleſs it remains poſſible that ſuch tranſmutations may be made.

The ſecond part of the forementioned reaſon ſhews plainly the great raſhneſs wherewith they affirm that which they know very little of; for there is nothing more experimentally known concerning Mettals, then their ordinary mixture with Brimſton; and the abundance of Brimſton in Minerals is an eſpecial good ſign of the richneſs; a ſufficient example whereof is the roſe-

coloured

coloured Oar of the famous mountain of *Sancta Iſabella* of new *Potoſi*, in the rich Province of the *Lipes*, which is almoſt all Plate, and engendred amongſt ſuch abundance of Brimſton, that the cavities, and hollow places in the Rocks are preſently all on fire, if a lighted candle touch them.

All thoſe Oars which they call *Soroches Mulatos*, and *Negrilios*, and all ſuch as do touch upon Antimony, or the Fire-ſtone, are certainly known to abound in Sulphur, (or Brimſton) as ſhall be declared hereafter.

In the very ſame manner is Quick-ſilver found incorporated with the Mettals, although it be leſs taken notice of, becauſe it is indiſcernable in the Oar, as it comes out of the ground, and when it is put in the fire the Quickſilver fumes away, and leaves no ſmell behind it, as the Sulphur does, but its effects are too well experimented in the deſtruction of thoſe that labour in the fumes where Oar is melted: and a few years ago we have been undeceived in this matter by the Oar of *Chalatiri*, (which is four

leagues from the City, the moſt celebrated, and rich one in the world, *Potoſi*) which being melted down, left in the furance a bar of Silver, and alſo a great deal of Quickſilver, which they picked out of thoſe aſhes that were cooleſt, the plenty of Quickſilver there did expoſe it ſelf to view; and afterwards taking more pains to work it in the ordinary manner, it produc'd as much Quickſilver as the richeſt Stones of *Guancavilica*, where it is poſſible there may be much Reliques of Plate in the great heaps of Oar, which hitherto they have refined; and I do not know whether ſome curious perſon has not already by accident found it ſo; when that that is already ſaid, ſhall not be held ſufficient to clear this point, it will bear no weight in the proof, that Mettals are not compounded of Quickſilver and Brimſton, to ſay that theſe two ingredients are not met withal in the Mines; for as parts of the compoſition of Mettals they have already loſt their proper forms, and are paſt into the nature of that Oar which is made

up

up of them. But the moſt skilful artiſts inquiring further into the ſecrets of Nature, do again extract from all ſorts of Mettal Quickſilver, whereof they ſay, they are moſt viſibly and palpably compounded. I forbear to ſet down the manner to avoid the occaſioning of Chymical experiments, which do more harm than good. In like manner common Quickſilver is turned into fine Plate, which is a certain proof of the poſſibility aud truth of what has been ſaid before, whereof there are ſo many eye witneſſes in theſe Provinces, that it were a madneſs to disbelieve them all.

CHAP. 20.

Of the efficient and formal cauſes of Mettals.

BEſides the Heavens, which as an univerſal cauſe, concurs in the Generation of all things, and particularly of Mettal; ſome other nearer efficient

cauſe is neceſſary, that having received vertue from the Planets, may work upon the proper matter of Mettals; for the qualities of the Elements alone are not ſufficient, nor are appointed to produce any compounded body, but only ſo far as they are govern'd by ſome other particular vertue, as is manifeſtly ſeen in living creatures. This next cauſe then, or Mineral vertue, or Spirit, ſerves it ſelf of the Elementary qualities, eſpecially of heat and cold, for its inſtruments in the generation of Mettals; the heat mixeth uniformly the earthy and humid parts together, which is the matter whereof Mettals are made, then it boils, digeſts, and thickens that matter, and the cold coagulates and hardens it, and ſo it hath put on the form of Mettal, and is more or leſs perfect, according to the preſent diſpoſition of that matter when the Mineral ſpirit began to actuate it: hereupon is grounded the opinion of *Calliſthenes*, *Albertus Magnus*, and others, who ſay there is only one kind of perfect Mettal, which is Gold; and that all the others

others we call ſo are but the principles or gradations unto that: wherefore they conceive it feaſible by art to reduce them to perfection, and turn them into Gold: they that oppoſe the poſſibility thereof, place the force of their arguments in proving that the ſeveral ſpecies of Mettals are compleat in themſelves, and diſtinct one from another; and therefore that a tranſition of one to the other is impoſſible. But their reaſon convinceth not, and if it were granted, the inference would not follow; for we ſee like tranſmutations, and far more difficult performed both by art and nature. By art Waſps and Beetles are made of the dung of Animals; and of the Plant *Alvaca* rightly placed and order'd Scorpions are produced. Alſo it is notoriouſly known, that in *Scotland* pieces of old Ships, and of fruit that falls into the Sea turn into living Ducks; and there is no compariſon between the diſtance of things Inanimate to Animals, and that of one Mettal to another. Beſides many other things that may be brought to this pur-

poſe, it hath already been ſaid, how ſome waters turn Sticks into Stones: And in the nouriſhment of all living Creatures, there is a continual tranſmutation: and in Mettals it is evidenced by the Stone *Lipis*, (or Copperas, blue or green) which (as hath been ſaid) being diſſolved in water withont any other artifice turns Lead, Tin, or Iron into fine Copper. And although it may be argued with probability, that Mettals do differ ſpecifically one from another, becauſe the definition of Mettal agrees to every one of them, as well as unto Gold, for the particular properties that agree to every one of them. And for that we ſee them permanent, and without any ſign, as if nature did endeavour to change one form into another, or heighten them into Gold; and for many other reaſons that might be alledged; nevertheleſs the contrary opinion of *Caliſtenes* and *Albertus* are very probable; for it is not concluding that two things differ *in ſpecie*, becauſe the ſame definition agrees to both of them, unleſs the eſſential difference

ference that conſtitutes them ſuch be ſhewn therein. As if one aſſert a Man and a Lion to be Animals, he cannot truly infer from thence, that they are of different ſpecies. For ſo *Peter* and *Paul* would be diſtinct in *ſpecie*, if it were not for the differences of rational and irrational that limit the *genus*. So although the definition of Mettal do agree unto Lead and Silver, as well as unto Gold, one cannot thence rightly infer that they differ ſpecifically, becauſe the one may be perfect as Gold, and the other imperfect as all the other within the ſame ſpecies of Mettal, as a child is in reſpect of a man, though both have the ſame eſſential definition; the child may grow up to perfection; and become a man. The different properties of Mettals alſo does ſomething ſtumble one, ſince they are accidents that accompany its imperfection, and ſo are capable of being removed: and the permanency which they ſeem to have in their kind, proceeds 1. either from the ſlowneſs of their growth, or melioration, which comes not within

the compaſs of humane obſervation; when even the growth of Vegetables is inobſervable, though after a great ſpace of time we can diſcern them to be increaſed. Or 2. from the covetouſneſs of mankind, that digs the Mettals out of the bowels of the Earth before they be come to their full maturity.

CHAP. 21.

Divers accidents of Mettals.

BEing diſſolved and returning to be coagulated again, is one of the accidents of Mettals, though it be found in other things alſo, yet in Mettals it is after a particular manner; the cauſe of this accident is the moiſture, whereof it is compoſed, the which as it is hardened by cold, ſo it is diſſolved by the heat of the fire, with more or leſs difficulty, according to the different proportion, and ſtrong or weak mixture of it with the Earthy ſubſtance. Tin has very much moiſture in it, and is very

very ill mingled with Earthy ſubſtance, and from this laſt comes the crackling and noiſe it makes between the teeth, when one bites it; and from both proceeds its facility to melt ſooner than all other Mettals: next unto it Lead melts eaſier than Silver, which hath need of a ſtronger fire, becauſe its Earthy and humid parts are well and ſtrongly compacted together, notwithſtanding the humid doth a little exceed. Gold becauſe it hath a better mixture of its parts, and Sulphur fix'd in its compoſition, or its earthy part, the pureſt that can be is harder to melt than Silver. Iron becauſe the earthy part is groſs and impure, and exceeds the humid, and their mixture alſo being ill and unequal, it burns and conſumes as often as it is heat in the fire, and will not melt of it ſelf without extraordinary great violence. Copper ſome do think to be a Mettal very near of kin to Iron, and although it has a greater proportion of moiſture in it, it is ſlower in melting, becauſe its earthy part is very aduſt and burnt.

The

The luſtre and ſhining of all Mettals proceeds, as it were, from one and the ſame cauſe; for when their ſuperficies is made plain, and ſmooth, or burniſhed, look how much the more pure and ſubtile the watry part of the Mettal is, ſo much the more luſtre they give. Gold excels all other Mettals in this, as well as in many other particulars, and next it Silver. White is a colour common to divers Mettals, although Silver be moſt perfectly ſo, I cannot imagine with what ſort of eyes *Cardanus* looked, when it appeared to him to be black; the cauſe of whitneſs is the moiſture being terminated by the dry, fine and well digeſted earthy part; for if it were dirty, impure, combuſt, it would produce a blacker and duſkeyer colour, and according to the difference of the earthy parts of Mettals herein, ſo do their colour come out more or leſs white. Gold is yellow, or red, which colour proceeds from the tincture that the Sulphur very much boil'd gives unto the Quickſilver, or moiſt parts, whereof it is compoſed, as

we ſee in all ſorts of Leigh, Urine, and other liquors boild upon ſtrong fires, that they have a red colour infuſed from the earthy ſubſtance, wherewith they are mingled; the colour of Copper proceeds from the ſame principle, although by reaſon of the impurity, combuſtion, and ill mixture of its parts, it does not arrive at the colour of Gold, much leſs to its richneſs and other noble qualities.

Generally Mettals neither taſte nor ſmell well, becauſe of their Sulphurious quality, although Gold ſmells and taſtes well, by reaſon of its moſt excellent temperature; or at the leaſt, it neither ſmells nor taſtes, ill, from the ſame cauſe alſo Mettals ſoil and black ones hands, or any other thing that touches them: but herein alſo Gold muſt be excepted, becauſe of its incomparable purity: another propriety of Mettals is to be ductile or malleable, which proceeds from the moiſture, being incloſed in the dry parts, which upon the ſtroke of the hammor gives way, and changes place, from whence pro-

proceeds the enlarging of the Mettal. Of all Mettals, Gold is the moſt ductile, next Silver, then fine Copper, Iron, Tin, Lead, *&c.* Mettals burn and are conſumed in the fire from unctuous Sulphur, or Earthy parts; as on the contrary, thoſe parts they have of moiſture or Quickſilver does defend and preſerve them from it: the parts of Gold and Silver are ſo pure and ſtrongly compacted together, ſo that the Earthy part defends the moiſt from evaporating, and the moiſture protects the Earthy part from burning, and ſo they indure the fire without any diminution or corruption. Other Mettals waſte in the fire for want of perfection and compactedneſs of the parts whereof they are compoſed.

CHAP.

CHAP. 22.

Of the number of Mettals, and the Places wherein they are Engendred.

THoſe who are vainly curious attributing unto the Stars andPlanets particular influence and dominion over all ſublunary things, do appropriate the production of precious Stones to the ſuperintendency of the fixed Stars, who ſeem to imitate them, not only in their brightneſs and luſtre wherewith they twinkle; but principally in the purity and permanency of their ſubſtance; as on the contrary, for the inſtability and alteration of form in Mettals, being ſometimes liquid, other times coagulated, they aſſign them to the particular government of the Planets, (who from the variety of their motions are called wandring Stars) moreover they aſſign the number, names, and colours of the Planets unto Mettals, calling Gold, the Sun; Silver, the Moon; Copper, Venus; Iron,

Iron, Mars; Lead, Saturn; Quickſilver, Mercury; although becauſe this laſt is not a Mettal, ſome inſtead thereof call Electrum Mercury, (which is a natural mixture of Gold and Silver) which was heretofore eſteem'd the moſt precious of all Mettals; but this ſubordination and application is uncertain, as is alſo the conceit that Mettals are but ſeven in number; whereas it is very probable, that in the bowels of the Earth there be more ſorts than we yet *know*. A few years ago in the mountains of *Sudnos* in *Bohemia*, was found a Mettal which they call *Biſſamuto*, which is a Mettal between Tin and Lead, and yet diſtinct from them both: there are but few that know of it, and 'tis very poſſible more Mettals alſo may have eſcaped the notice of the generality. And if one ſhould admit the ſubordination, and reſemblance between Mettals and the Planets, modern experience, by excellent Teliſcopes has diſcover'd, that they are more than ſeven. *Galileo de Galiles* has written a Treatiſe of the *Satelites* of *Jupiter*, where one may find

find curious obſervations of the number and motion of thoſe new Planets.

Reaſon and experience teacheth, that the moſt proper place for the generation of Mettals is the veins of the Earth, which do run through its great body as principal receptacles of its permanent humidity, proportionable to its ſolidity and hardneſs, as blood is in the bodies of Animals. The Rocks between which Mettals commonly are engendred, which they call *Caxas*, (or *Cheſt*) ſerve for Conduits, where ſubterraneal and Celeſtial heat meet and unite the one with the other, ſtirring up vapours, mingling and purifying the matter of which Mettals are made, without giving it time to divert and diſſipate into ſeveral places; that which communicates between Cheſt and Cheſt is called a Vein; and that which time has moulder'd off, or the Rains carried away from the matter that fills it, is found ſcatter'd up and down the mountains broken, and tumbled away by themſelves, which are the Stones of Mettal; thoſe that underſtand this art beſt

beſt believe that the Gold that is found in the Sands of Rivers has the like Original, that it is not engendred in the Sand, as divers will have it, but in veins of the Earth carried from thence by rains unto the Brooks; yet be this how it will, (although what has been ſaid is the more natural and ordinary way of proceeding) oftentimes it happens, that in ſome parts or bits of land they find that which is called *Creoderos*, where Mettals are engendred out of Veins by the diſpoſition of matter, and the powerfulneſs of the Mineral vertue which there meet together.

CHAP. 23.

The manner how to find out the Veins of Mettals.

THe Veins of Mettals are diſcovered either by art or fortune. Violent currents of water waſh off the firſt coat of the Earth, and ſo leave the veins of Mettal naked to the eye, if there be any

any there: great ſtorms of wind many times tear Trees up by the roots, and with them ſome Stones of the Mettal of that place: the ſame effect alſo hath the falling of pieces of Cliffs and Rocks caus'd either by thunder-time, or great rains, and waſh away the cement that ſhould hold them together. Often-times rich veins of Mettal have been diſcovered by the Plough, whereof *Juſtin* makes mention of Gold that was found in *Spain*. In my own ground, a quarter of a league from *Chuquiſcaca*, ploughing upon the ridge of a hill, I diſcover'd a vein of *Soroches*, and 'tis very probable that the like happens in divers other parts of theſe Provinces, which are ſo fertile of Minerals; & that the ignorance of the Plough-men hath been the cauſe they have not profited by the riches which fortune has put into their hands. *Lucretio* in elegant Verſes hath ſet forth, how that the mountains being ſet on fire, either on purpoſe, or by chance, diſcovered the nature of Mettals unto the world, melting them, and making them to run out

of the Rocks wherein they lay conceal-ed, into the form that now they are known. By the ſame accident alſo have been, and may be hereafter, be-cauſe of diſcovering the veins of Met-tals, which the Hiſtories of *Spain* con-firm unto us in the burning of the *Pere-nean* mountains; and much leſſer vio-lences than thoſe have been ſufficient, when fortune has had a mind to diſtri-bute Riches to her favourites. A man riding a horſe-back over the Country in *Goſolaria*, by the ſoil broken with the ſmall force of his horſes feet, diſco-ver'd a very rich Mine, as *Agricola* re-ports. An *Indian* ſervant of mine pul-ling up by the roots ſome buſhes of *Tola*, a ſort of wood, ordinary in this Coun-try, together with the roots pluck'd up a rich Stone of Mettal, which was Silver, white, and in duſt; this was half a league from the Mines of St. *Chri-ſtopher de Achacalle*; he brought me home the Stone, whereby I diſcovered the vein of Silver, and ſhew'd the place unto the Officers of the Mines.

When

When the rich Mines of *Tuno*, in the Province of *Carangas*, began to be famous for the riches, abundance of Soldiers flocked down thither; ſome of them being very poor, fortuning to have no ſhare in the Veins that were already diſcovered, and conferring together how they ſhould get their living, ſaith one of them; if God pleaſe, here we ſhall get enough to maintain us; together with which he kick'd the ground with his foot, and under that ſmall deal of Earth, which ſo ſlight a blow could turn up, they ſaw a piece of white ſilver, which they took up, with incredible admiration, and therewith ſuppli'd their preſent occaſions, without any further labour, (the piece of Silver being about the bigneſs of *Botijuela*) and afterwards the vein of Silver in duſt, which was found underneath that Stone (or rather pure Silver) yielded much riches both to them and others. That mine is called the Poor mans Mine, and is the richeſt of all that were in

Botijuela *is a Spaniſh veſſel, which containes about a Gallon.*

that famous farm. The Mine of St. *Chriſtophers* in the *Lipes* was alſo found out by chance: amongſt the Rocks thereof breed great ſtore of *Biſcaches*, a little creature about the bigneſs of a Hare, (game very ordinary, and of good nouriſhment in theſe parts) one of theſe being kill'd with a Gun, the man that ſhot her, found her dead upon a rich [*farellon*] of Silver, and called this Vein, *Neuſtra Seniora de la Candelaria diſcubredora*, afterwards they regiſtred divers other Mines, which made that Farm ſo deſervedly famous, as that abundance of *Spaniards* reſorted thither, and that it is reckoned the third beſt Mine in all the *Indies*, namely, next unto *Potoſi* and *Oruro*.

CHAP.

CHAP. 24.

Beſides thoſe Veins of Mettal, which do diſcover themſelves, or are found by chance, as has been ſaid before, there be others procured by the Art and Induſtry of Man.

THe colour of the ſuperficial Earth is no ſmall indication, whether or no there be Mettal in the bowels of it, as has been ſaid in the firſt Chapter of this Treatiſe, and hath been found by experience in all the Mines hitherto diſcovered in this Kingdom, the ſuperficial Earth of them being of a far different aſpect from other Earth, even to the ſight of thoſe who are very little vers'd in this matter. There is no certain infallible rule by the colour of the Earth, to judge what kind of Mettal it contains, that being only to be known by experience and enſaying, as we ſee in Gold, which is ordinarily found in red Earth, or yellow tinctur'd with red,

like unto a hard burnt Brick: nevertheleſs in the Mines of *Oruro* and *Chianta* the Veins of it are found in white Chalk; in theſe Provinces the Earth of other Minerals moſt commonly is reddiſh, of the colour of Wheat, after the pattern of *Potoſi*, (their firſt copy) of the ſame colour is that of *Seapi*, *Perira*, and others in the *Lipes*, which produce Copper; and although ſometimes the Earth is found of grey, green, and red colour; yet generally it is of the colour of Wheat. The very ſame kind of Earth likewiſe is found in the Lead Mines; ſo that the true knowledge of what ſpecies the Mettal is depends upon the enſaying of the Oar.

The veins of Mettal are found ſometimes above ground in great *Stones*, which being broken, the Miner diſcerns that they contain Mettal and enſays them, and ſinks his Mine there, if he finds encouragement, and that it is like to be profitable; but if the veins be covered, they hunt them out, after this manner, *viz.* taking in their hands a ſort of Mattock, which hath a Steel point

point at one end to dig withal, and a blunt head at the other end to break Stones withal; they go to the hollows of the mountains, where the downfall of the rains deſcends, or to ſome other part of the skirts of the mountains, and there obſerve what Stones they meet withal, and break in pieces thoſe that ſeem to have any Mettal in them: whereof they find many times both midling ſort of Stones, and ſmall ones alſo of Mettal. Then they conſider the ſituation of that place, and whence thoſe Stones can tumble, which of neceſſity muſt be from higher ground, and follow the track of theſe Stones up the hill, as long as they can find any of them, and when they are gotten ſo high, that no more of theſe Stones appear, it is a certain ſign, that there or thereabouts begins the Vein, there then they break Earth, and run their Mines according as the veins of Mettal, which they meet withal guide them.

The guſhing out of water in the ſides of the hills are very good ſigns, that the veins of Mettal are near, becauſe

commonly they are the conduit-pipes of them.

When Trees, Buſhes, and other Plants, and Weeds of the ſame ſort, are found to run along in rows, as if they were planted by a line, oftentimes it proves, that a vein of Mettal runs underneath them.

The Plants that grow over the veins of Mettals, are not of ſo great a growth, nor ſo ſtrong a colour, as others of that kind, becauſe the exhalations, which come from the veins blaſt them and hinder their perfection; for the ſame reaſon alſo, the morning dew, and the ſnow which falls is gone ſooner from thoſe mountains that have Mines, than from thoſe that have none, and from the place where the veins run, ſooner than from other places of the ſame mountain.

CHAP.

CHAP. 25.

Of the ſeveral ſorts of Veins, and how to find them out.

ALthough the word Vein be a general term given to all places, that contain Mettal, yet in the particular ſpeech of the Miners it is applied to thoſe Veins that run down perpendicularly, or ſlooping; (which is more uſual) from the Horizon, and thoſe veins which run parallel in the ground, without any conſiderable depreſſion from the Horizon, they call *Manto*, (a word which ſignifies a cloak or blanket, which the women in *Spain* throw over their heads and ſhoulders.) Both theſe ſorts of veins are uſually found, although moſt commonly the Mines that are wrought are thoſe that run downwards; thoſe veins which are found ſeldomeſt of all, are thoſe the *Spaniards* call *Sombreros* (which in their language ſignifies a Hat) or a heaped Mine,

Mine, which is where Mettal is found in a lump together, in what quantity or diſtance ſoever, from which no veins run, either downward or ſideways.

In what vertical plain the veins of Mettals generally run, hath been curiouſly obſerved by all the Miners of *Europe*, as being certain ſigns of the greater or leſſer riches, and abundance of the Mine, eſteeming principally thoſe veins that run from Eaſt to Weſt, or thereabouts, in the northern part of the mountain; next they eſteemed thoſe beſt (in the northern part of the mountain) that run North and South, or thereabouts. They gave the third place of eſtimation to thoſe veins which run North and South, on the Eaſtern ſide of the mountains, and valued thoſe little or nothing at all which ran the contrary way. Whether the veins do run Eaſt or Weſt, is eaſily ſeen by the grain of the Stones in the joyning of the Stones together, or cheſts that contain the Mettal, becauſe that runs towards the part where the Mine ends; a thing eaſie to be obſerved in the pieces of the Rocks

Rocks that are found above the ſuperficies of the Earth; and thoſe within the bowels of it, run after the ſame manner: other ſuch like ſigns they give us, whereby to know thoſe Brooks or Rivers that have Gold in them, but with leſs reaſon, becauſe the Gold is not engendred there, but in the veins of the mountains, from whence time and the downfalls of water have worn it away; but without diſparaging the judgement of thoſe that have thought as aboveſaid, and have written to that purpoſe; I ſay that for the moſt part in the Mines of *Europe*, and of theſe parts, experience hath ſhewed the contrary, which I foreſee they will anſwer, by ſaying, that oftentimes an effect is produced contrary to expectation, and that theſe have their exceptions as well as other rules; nevertheleſs if it be lawful for us in this other world, and oppoſite Climate, to make new rules from the experiences in the rich Mines of *Potoſi*; I ſhould aſſign the firſt place of riches, and abundance to thoſe veins that run North and South upon the northernſide of

of the mountain; which point of the Compaſs, with a very little declination Weſtward, the four principal Mines of this mountain obſerve; namely, the Mine of *Centeno*, which was the *Deſcubridora*; the Rich mine; the Tin mine; and the mine of *Mendieta*: the ſecond place I ſhould give to them, that run North and South, on the South ſide of the hills. A point of the Compaſs parallel, whereunto run the beſt veins of the ſecond famous Mine of this Kingdom, which hath its name from the famous City of St. *Philip* of *Auſtria* called *Oruro*, which in the richneſs of its veins, abundance of Mettals, depth of its Mines, and great concourſe of inhabitants, deſervedly ſtands in competition with the grandeur of *Potoſi*.

In divers places very rich veins of Mettal run Eaſt and Weſt, and alſo to ſeveral other points of the Compaſs; ſo that the beſt rule to go by in this matter, is to follow the Mettal, as it diſcovers it ſelf, and as long as one gains thereby, or at leaſt ſaves himſelf, it is worth the following on, becauſe being ſure to

loſe

loſe nothing one hath, the vein will lead him to great riches; and if the vein be large, and have any ſigns of Gold or Silver in it, although for the preſent it doth not quit the coſt, men go on couragiouſly in the working of it, having ſuch certain hopes of gaining great profit; this hath been confirmed by experience in all the Mines of theſe Provinces; a freſh inſtance whereof we have in the rich Mine of *Chocaia*, (where for the inſtruction and encouragement of Miners) after having followed its veins forty years, with very little profit, at length they have met with the extravagant riches, which all of us in this Kingdom have heard and ſeen. If the veins of Mettal be very ſmall they muſt be extream rich to be worth the following: if the Mettal be found clinging about Stones, and likewiſe in the hollows of thoſe Stones, it be found in grains like corns of Gunpowder, (being that which the *Spaniards* call *Plomo*) and is Silver unrefin'd, although theſe grains be but few, and thereſt of the Mettal have no Silver in it,

it, nevertheleſs it is a ſign of the riches of the vein, when it meets with more moiſture. As it fell out in that great Mine of St. *Chriſtopher* of the *Lipes*, which they call the Poor man's Treaſure, if as they dig forwards they meet with more abundance of thoſe grains, *de Plomo*, it is a ſign that the rich Oar is very near. To find *Chriſocola*, *Herrumbre*, *Orpimente* or *Sandaraca* in the Mines, or iron-colour'd earth, next to the Stones that incloſe the Oar, or Fullers-earth between thoſe Stones, are very good tokens of the richneſs of the Mine; it is no ill ſign alſo to meet with dry Earth, if it be yellow, red, black, or any other extraordinary colour, and 'tis the better when there is ſome ſhew of Lead mixt with it: Chalky-ground is very promiſing, and *Agricola* doth judge it a good ſign to meet with Sand in the Mines, if it be exeeding fine, and very ill to meet with Earth full of little Flints, if it hold long, without changing into another ſoil.

CHAP.

CHAP. 26.

Of Mettals in particular, and firſt of Gold.

THe moſt perfect of all Inanimate bodies, and the moſt eſteemed of all Mettals is Gold, univerſally known, and coveted by all people. It is made of the ſame matter, and in the ſame manner as other Mettals are, (as hath been already ſhewn) but of parts ſo pure and perfect, and ſo well compacted togther by decoction, that its ſubſtance is, as it were, incorruptible, being out of the power of any of the Elements to be corrupted or deſtroyed. The fire that conſumes all other Mettals, only makes Gold more pure: The air and water diminiſh not its luſtre, nor can Earth make it ruſt or waſte. By the nobleneſs of its ſubſtance, it hath moſt deſervedly obtained that eſtimation, which the world gives it, and the natural vertue which flows from the admirable

mirable equality of its compoſition, is the beſt medicine againſt melancholy, and the greateſt cordial to the hearts of men, which perpetually run after this avaritious Mettal, as the Needle doth after the Loadſtone. The qualities that it hath in common with other Mettals, have been briefly touched in Chapter 21. The vertue aſcribed to *Aurum potabile* to preſerve a body perpetually in youthfulneſs, without infirmity; together with the receipt of making thereof, depends upon the credit of thoſe Authors, who have written concerning the ſame. Many writers upon this ſubject relate the names of divers Countries, Mountains, and Rivers, famous for the production of Gold, but my deſign is not to be over-large; and therefore I not only forbear to tranſlate what other men have written, but alſo to treat of the greateſt part of the Mines in this new world, even thoſe of divers of the Provinces of *Peru*; and only apply my ſelf to give your Lordſhip a ſhort account of thoſe which are found in the Royal *audiencia de los Charcas*,

Charcas, the government whereof is worthily committed unto the care of your Lordſhip. Every body knows the name of *Carabaya* for being a Country ſtored with plenty of the fineſt Gold, (as fine as the fineſt Gold of *Arabia*) it is of the *ley* of 23 *Corrats*, and three grains; and although an incredible quantity thereof hath been, and daily is gotten thence, yet now they begin to work again a-freſh, and follow the veins of it under ground, whereas hitherunto they have only gathered up the fragments of it, which were waſhed off by the rains. The Province of *Larecaja* borders upon *Carabaya*, and abounds with Gold, which in divers Brooks of that Country, is found in form and colour like unto ſmall ſhot, which being melted, and its outward coat and mixture conſum'd away, becomes of a red colour; he that found this firſt did not know it to be Gold, until a friend of his, unto whom I diſcovered it, told him ſo.

Next unto *Larecaja* joyns *Tipuáne*, a Country inhabited by ſavage *Indians*,

with whom we have had wars, and made incurſions upon them, ever ſince the building of the City *de la Paz*, where I was preſent, and is now above twenty years ago: this Country is ſo largely reported to be rich in Gold, that it were incredible, unleſs ſo many eye-witneſſes had affirmed it: the proper name of this City *de la Paz*, is *Chuquiyapu*, which we corruptly call *Chuquiabo*, which in the language of this Country, is as much as to ſay *Chacra*, or the Farm of Gold; it hath abundance of Mines in it, that were wrought in the time of the *Ingas*; it is a ſoil generally known to be fertile of Mettals; and in the time of the rains the Boys often pick up Gold in the ſtreets in ſmall bits, like the kernels of apples, eſpecially in that ſtreet that goes down to the River, by the convent of the *Predicadores*; and in the valley of *Coroico*, and others, which they call *andes de Chuquiabo*, in the cliffs of the Rocks Gold is found of a grey colour on the outſide, like unto Lead. The Silver Mines of the famous Town of St. *Philip*

of

of *Auſtria*; *Oruro*, are encompaſſed round about with other hills, in which there are many rich veins of pure Gold, which have been wrought heretofore; at preſent there is only one wrought, and that by my perſwaſion: upon the ridge of that mountain, that runs over the Silver-mills, which they call *de las Sepolturas*, the Oar whereof being well ground to powder, and enſayed by Quickſilver, yields a conſiderable profit, they have not followed any more of the veins, for want of induſtry, their common trade being getting of Silver, (or which I rather believe) becauſe in thoſe veins they have already wrought, they have not gotten ſo much Gold as they expected; although that ought not to diſcourage them, becauſe it may reaſonably be ſuppoſed, that where ſo many veins of Gold are, there be ſome of them very rich, if they have the good fortune to light upon them, the ſame which daily experience hath ſhewed in the Mines of Silver.

The bounds of *Chayanta* are full of veins of Gold, and have ſome ancient

Mines already ſunk in them, and in the Sands of its River, which is called, *el Rio grande*, kernels of Gold are found, and in the River of *Tinquepaya*, ſeven leagues from this City of *Potoſi*, they have found Gold alſo.

In the Confines of *Paccha*, *Chuquichuqui*, and *Preſto*, near unto the City of *Chuquiſaca*, there be many Caves, out of which they have gotten ſome ſhew of Gold: the like alſo is found from the River *Sopachuy*, up unto the *Chiriguanes*, where it is held for certain, that there be rich Mines of Gold, which the *Indians* have this year offered to diſcover unto us.

The River of St. *Juan*, which runs at the bottom of the Province of the *Chiquas*, where it joyns with the *Calchaquies*, is very full of Gold; in *Eſmoraca*, and *Chillio*, of the ſame Province the ancient Gold Mines are yet to be ſeen: there is one hill of the *Lipes*, which is near unto *Colcha*, which hath Gold in it: there is a Mine alſo three leagues from this Town, in a place they call *Abitanis*, which in the *Lipean* language

guage is as much as to ſay the Mine of Gold. I believe for a certain alſo, that there is Gold in the Province of *Atacama*, becauſe of the abundance of fine *Lapis Lazuli*, which is found there, in which Gold is engendred.

CHAP. 27.

Of Silver, and the Mines thereof.

SIlver is the moſt perfect of all Mettals, except Gold, whereunto it comes ſo near, as to want nothing but the colour; and therefore thoſe that moſt of all oppoſe the opinion of the tranſmutation of Mettals one into another, do yet hold it poſſible to turn Silver into Gold, becauſe the colour only being wanting, the fire, and artificial concoctions can ſupply that, whereof there be many experiments: from the good mixture, and fineneſs of its parts, proceeds its enduring the fire with very little waſte, as alſo its being tough and malleable, and endures the drawing out

into very thin leaves, and ſmall wyre; if it were not a common trade to do it, it would not be believed to be poſſible, that an ounce of Silver ſhould be drawn out into 1400 yards of wyre; and it is yet more admirable, that all that ſhall be made gilt wyre, with only ſix grains of Gold; ſo that although Silver can be extended to admiration, yet Gold is a hundred times more ductile than it; one ounce of Gold ſuffering its ſelf to be beaten to that thinneſs, as to overſpread ten *Hanegadas* of land.

In the Mines oftentimes Silver is found white, and pure, and like, as it were, wyre woven one within the other between the Rocks, which the *Spaniards* call *Metal Machacada*, ſuch as is found in that Mine they call the *Turks*, in the Province of *Carangas*: in *Choquepina* a Mine of the *Ingas*, two leagues from *Berenguela*, in the Province of the *Pacages*: in the mountain that I diſcovered and regiſtred, half a league from the works of St. *Chriſtopher*, in the Province of the *Lipes*: in *Tara*, of the Province of the *Charcas*: (which in

in the middle of its Oar yields rich Copper) there was found laſt year a Stone coated over with white Silver, the Mettal contained within, being yellow, like unto the colour of a Lion. And in the rich Mine of *Chocaya*, in the Province of the *Chichas*, in the richeſt Stones of that Oar they have found much Silver, like wyre woven together as aforeſaid; and in all the Mines of theſe Provinces, at ſome time or other Stones have been found, made into Silver wyre as aforeſaid, and wedges of pure Silver; but no other Mine hath produed the like unto that of St. *Chriſtophers* in *Oruro*, which beſides the leaves of fine Silver, that are found between the Stones, produceth fine Silver alſo in ſmall duſt mingled with the mould, or earth, that is dug there, which may be gotten together without any more trouble than waſhing, in the ſame manner as they uſe the Gold that is found in ſand; but moſt commonly in all Mines Silver is found incorporated with the Stones, and is ſcarce diſcernable, nor to be known, but by

men of good experience. In the circuit of the *Charcas*, there is ſuch abundance of Silver Mines, that they alone, if there were no other in the world, were ſufficient to fill it with riches: in the middle of this juriſdiction ſtands the wonderful mountains of *Potoſi*, of whoſe treaſure all Nations of the world have liberally participated; the excellencies whereof,& of that imperail City, whereunto it hath given the name, do ſo much ſurmount any other thing in the old, or new world, that they very well deſerve a particular hiſtory to eternize their fame: it is ſurrounded (for the moſt part) with abundance of rich Mines, that of *Porco* is the famous Mine of the *Ingas*, and the firſt, out of which the *Spaniards* dug any Silver; thoſe very ancient Mines of *Andacava* are admired by all Miners for their vaſt depth, and admirable contrivance, and plenty of Oar, which is ſuch as promiſes continual employment, for half the *Indians* of this Kingdom. Thoſe of *Tabacco Nunio* are near unto a Lake called by the ſame name, have ſuch wonderful

and

and coſtly engines appertaining to them, that the building of them hath conſumed a great part of the treaſure of this Kingdom: that Lake contains ſo much water, as would make a running river all the year long, with which there goes day and night a hundred Silver Mills, which grind the Oar which is gotten from its own banks. Within the bounds of *Potoſi* alſo are the Mines of *Guariguare*, *Caricari*, *Piquiza*, *la vera Cruz*, *Sipoto*, and many others.

In the *Lipes* there be Farms of Mines of greater fame, namly that of St. *Iſabel* of new *Potoſi*, the name whereof doth not more predicate its beauty, than doth the amenity of the mountain, and the richneſs of the Oar that is found there. *La Trinidad* is a wonderfull rich Mine, there be alſo the Mines of *Eſmoruco*, *el Bonete*, (which they call ſo, becauſe the top of the mountain is like a Bonnet.)

Xanquegua, the new world which hath been diſcovered in my time, yields very rich veins of Mettal; namely, *Abilcha*, *todos Santos*, *Oſloque*, *St. Chriſtoval*,

ſtoval, *de Achocalia*, *Sabalcha*, *Montes claros*, and many others. In the *Chicas* are St. *Vincent*, *Tataſi*, *Monſerrat*, *Eſmoraca*, *Taſna*, *Sbina*, *Chorolque*, old and new *Chocaya*, which to the ſhame and aſtoniſhment of the Miners, hath been now laſt of all found out, and is one of the richeſt in all *Peru*.

CHAP. 28.

Continuing the diſcourſe of the laſt Chapter, touching the Mines of Silver.

THe Province of the *Charcas*, beſides the rich mountain of *Potoſi*, (which alone was ſufficient to eternize its name) and the other Mines aforeſaid, that are round about it hath alſo the Mines of *Yaco*, (or the mountain of miracles) thoſe of *St. Pedro de buena viſta*, and thoſe of *Malcocota*: there is Silver Oar alſo found near unto *Cayanta*, and alſo in *Paccha*, and *Tarabuco*, not far from *Chuquiſaca*, and in other places. Within the Juriſdiction of *Panna*, ſtand

ſtand the three great mountains, *St. Chriſtoval*, *Pie de Gallo*, and *la Flamenca*, which together make up thoſe Mines, which they call of *Oruro*, that famous Town, which is near unto them. In the neighbourhood of *Oruro* alſo are the Mines of *Avicaya*, *Berenguela*, *Cicacica*, *la Hoya*, *y Colloquiri*, which although it is a Mine of Tin, yet now and then in following the veins thereof they meet with rich Oar of Silver, which they call *Lipta*: In the Province of the *Pacages* is the rich Mine of *Berenguela*, with the mountains of *Santa*, *Juana*, *Tampaya*, and others, and in the bounds of the City *de la Paz*, there are the Mines of *Choquepina*, *Pacocava*, *Tiaguanaco*, and divers others; briefly all theſe Provinces are nothing but a continued Mine, and notwithſtanding ſo great a number of Mines are opened at this day, yet it is certain, that there be many more known unto the *Indians*, which they craftily have concealed from us till this preſent.

There is a certain tradition in this Country of an incomparable rich Mine belong-

belonging to the Village of *Chaqui*, four leagues from this Imperial City, although at preſent the ſight of it is not known, divers *Indians* having killed themſelves out of obſtinacy, that they might not diſcover it.

There goes no leſs fame of the Mine, which they call *de los Encomenderos* in the Province of the *Lipes*, which name was given it divers years ago by the *Indians*, who getting a great quantity of Silver out of that Mine, gave that Treaſure unto two *Spaniards*, whom they diſpatched away into *Spain*, as their Agents, (they were two brothers of the ſirname of *Tapias*) whereupon this rich Province was incorporated into the Crown. Whileſt I was Curate of this place, I ſpoke with many of the Country people, that told me, they had helped to load, and conduct that riches unto the Port of *Arica*, where it was put on Shipboard: it is agreed on all hands, that the aboveſaid report is true, although at preſent that Mine remains undiſcovered, which I do not at all wonder at, when I conſider, that all the

the Mines that are wrought in that Province have been found out, and firſt taken ſay of, by the *Spaniards* themſelves, without lighting upon any one ancient work of the *Indians*; whereof no doubt there were formerly very rich ones, as appears by the choice Stones, and pieces of Oar, which *Indians* have given me, without diſcovering whence they had them: and the very ſtreets of the Town, when I was Curate there, were full of ſmall grains of rich Oar, which I ſwept up, and made profit of it. In the plains of *Julloma* in the *Pacages*, the *Indians* anciently have wrought Mines, which at this day remain undiſcovered. It hath been a vaſt quantity of ſmall pieces of Plate, which they call *Corriente*, that the *Spaniards* have bought up, among this people, and I my ſelf have gotten there ſome of the remainders of that ſort of Silver: theſe grounds, together with the colour and beauty of the mountains, makes one rationally to ſuſpect that Country to be fertile of rich Mettal: but it is more certain, that there are rich Mines in the Pariſh

Pariſh of *Caquingora*, in the ſame Province of the *Pacages*, becauſe I have ſeen Stones of rich Oar picked out of the paving of their ſtreets, and the walls of their houſes. The ſame report goes alſo of divers of the neighbour Towns and a conſtant fame, that in the time of the *Ingas*, each of the parties had their particular Mines

CHAP. 29.

Of Copper, and the Mines thereof.

THe Sulphureous parts do predominate in the compoſition of Copper, and from their diſtempered heat riſes the fiery colour of that Mettal; when it is melted it ſmells more of Brimſtone than any other Mettal; and becauſe it is over-burnt in its compoſition, therefore it is leſs ſubject to injury or corruption, by the air, earth, or water; as for the ſame reaſon, Coals are not ſubject to ſuch like accidents: they uſe Copper about engines of long duration, becauſe

becauſe it never ruſteth as Steel and Iron doth; and for the ſame reaſon it was highly eſteemed by the Ancients, who made the bolts and nails of their Ships, their weapons, and other inſtruments of this Mettal, which alſo we found in uſe among the Natives of this Kingdom.

Copper is engendred in mineral Stones of divers colours, although ever the moſt predominant colour is blew or green: it is engendred in the ſame places with Gold and Silver, and oftentimes in following a vein of pure Copper they have met with a neſt of the fineſt Gold; but it is more familiar to have its veins change into Silver; and thoſe veins of Copper that make any ſhew above ground, commonly prove very rich as they are dug deeper, and conſequently are more moiſt. The Mine of *Oſloque* in the *Lipes*, was at the top in a manner all Copper; and every ſpades depth as they dug downwards the Oar grew more rich in Silver, until it came to be pure Silver, at the bottom of the Mine, where the water

increa-

increaſing to a mans height hindred them from proſecuting its farther riches: what hath been ſaid is a token of the affinity between the matter of compoſition of theſe Mettals, and that the greater or leſſer purification is the only difference between them.

There are many Mines of Copper in theſe Provinces, and the bottoms of all the Mine whereout Silver hath been taken, have been found to yield great ſtore of it, which for the colour ſake they call *Negrillo*: ſo that how many Silver Mines there are, ſo many Mines there be whence Copper may be gotten alſo; beſides there be Mines of Copper only from the very ſuperficies of the Earth downwards; there be divers ridges of hills about *Potoſi*, that are full of theſe kind of Mines, although moſt of the Copper that is wrought in this Town hath been gotten from the Farm *de las Laganillas*, and now is gotten from that of *Yura*. In the *Lipes* there is a very great old work of Copper in the mountain *Scapi*, two leagues from *Chuyca*: there is another alſo, wherein there

there is Copper-mettal like wyre woven. A league from *Sabalcha*, in the high way to *Colcha*; and notwithſtanding it is found in many parts of this Province, yet no where is the ſucceſs ſo proſperous, as in the mountain of *Pereira* and its confines, until you come to *Guatacondo*.

In *Atachama* there are very large veins of Copper, ſome of them run unto the Sea ſide, and tumble down the cliffs in great maſſy lumps of this Mettal. In the *Chicas*, where the ſoil is not taken up with Silver, 'tis full of Copper mines; and not far from *Eſmoraca*, they get of this Mettal, woven like wyre, (or *Machacado*, as the *Spaniards* call it) there is alſo very rich Copper in *Oroncota*, and in the top of the mountains of *Tarabuco* many Pits and Copper-works of the ancients are to be ſeen. It is found likewiſe in all the reſt of the *Charcas*, particularly in the confines of *Maoha*, *Copoata*, and *Chayanta*; and in *Paria* near unto *Oruro*. And in the Province of *Carangas*, the hills adjoyning to the Silver mine, cal-

led *el Turco*, are full of Copper. Near unto *Curaguara de Palages*, there be many ancient works of the *Indians*, whence they get Copper *Machacado*, (or like wyer woven together.) In the high way between *Potoſi* and *Julloma*, one ſees many veins of Copper. Alſo a league from *Callapa*, in the road that goes to the City *Paz*, one croſſes ſome large veins of it. Not far from *Caquingora* there be divers ſtately works, and much Copper *Machacado* upon a white chalk. Within leſs than half a league from *Julloma*, near unto the high way that goes to *Calacoto*, in hills of dry clay, I found branches or ſmall veins of pure Copper, like unto fine Gold, whereof I got a great quantity of that which was ſcattered about above ground. There is of this mettal *Machacado* in *Choquepina*, near unto *Berenguela de Pacages*; and ſeveral works and virgin veins in the high way from *Calacoto* to *Potoſi*, half a league before one arrives there, and in like manner over all the reſt of this Province.

CHAP.

CHAP. 30.

Of Iron.

IRon, although it is not the moſt precious, yet it is the moſt neceſſary of all Mettals for the uſe of man; notwithſtanding it may be diſputed, whether the good or hurt it hath done in the world, be the greater; nature hath made it ſo hard, by putting over much earthy parts or fixed Sulphur in its compoſition, although it hath alſo a ſufficient portion of humidity, or Quickſilver, ſo that in the firſt place it will not melt without a very violent heat; and in the next place, being ſtruck with a Hammer, it doth not break into ſmall pieces, as hard Stones do, but receives impreſſion, thereby dilating and extending it ſelf. It is a Mettal cold, and dry, but more porous than others, and therefore weighs leſs, and is more ſubject to ruſt, and decay in the wet: eſpecially in Salt-water, which pene-

trates moſt: it waſtes in the fire alſo every time it is heat, falling off in ſcales, becauſe it wants humidity proportionable to its earthineſs. If when it is red hot it be quenched in cold water, it will become very brittle, becauſe the heat being pent up in the heart of the Iron by the ambient cold, doth there prey upon, and conſume part of the natural moiſture, which made it tough, and malleable.

Theſe fertile Provinces of all other ſorts of Mettal are not deſtitute of this alſo, though none employ their labours to ſeek it out, or work it; becauſe here is ſuch abundance of Silver, about which they are induſtrious to greater profit, and in truck for it, they buy abundance of that excellent Iron of *Biſcay*: this proceeding is not to be wondred at, when one conſiders the abundance of Copperas, Allum, Quickſilver, and other Minerals, which is yearly brought from *Spain* to theſe *Indies*, where the ſame commodities may be gotten in ſuch abundance, as were ſufficient to ſupply, not only the occaſi-

ons

ons of theſe Kingdoms, but alſo of *Spain* its ſelf, and of all the world beſide.

In the valley of *Oroncota*, there is a great deal of Iron, the people of the Country, being encourag'd by the looks of the place, and fair appearance of the Oar they found, followed a large vein of Mettal, hoping that it was Silver, and brought me ſome of the Oar to enſay it, the which I did, and undeceived them, by telling them it was Iron: the ſame has happened in other veins at the riſe of the River *Plicomayo*, five leagus from the City *de la Plata*, although that Oar has ſome Copper mingled with it, and is not pure Iron as that of *Oroncota* is.

Adjoyning to the *Ancoraymes*, a Town in the Province of *Omaſuyo*, there be noble Mines wrought formerly by the *Ingas*, of ſo great fame, that it is very well worth ones making a journey purpoſely to ſee them: the Oar is very heavy, and hard, and of a dark colour, although there be found together with it much Oar, that ſparkles and ſhines. If you rub pieces of the dark Oar to-

gether, it produceth a very fine blood colour, like that of the *Hemmotites*, to whoſe ſpecies undoubtedly it belongs, and is full of Iron, as I have proved by many enſays; it is poſſible the *Indians* followed veins of richer Mettal in theſe Mines, which hitherto we have not met withal, or becauſe Iron was not in uſe amongſt them: they dug this Oar to fit it to their Guns, Stone-bows, and Slings; it being not inferior in weight or hardneſs to our Iron bullets, they did make uſe of theſe in their wars, and called them *Higuayes*.

In *Oruro*, hard by the Silver Mine of *Santa Brigida*, in the hollow between the hills, there is a vein of Iron, of which out of curioſity, and for example only, when I was in that Town, I ſaw ſeveral Iron Keys made: the Mettal which they call *Chumbri*, taken out of the Mine of *Chocaya* in this mountain of *Potoſi*, and others, have much Iron in them: and doubtleſs there is abundance of Iron in many other parts of this Kingdom, although the people do not regard, or ſeek after it, nor do the Miners

ners in their ordinary enſays meddle with any thing, but the knowledge of Gold and Silver.

CHAP. 31.

Of Lead.

LEad is a very common, and known Mettal, there is no Silver Mine, where much of it is not found; and there is ſcarcely any other Oar but has ſome mixture of Lead in it. Nature hath qualified it with abundance of humidity, that it might be ſerviceable in the melting of Gold, and Silver, which without the help of Lead burn away, and conſume in the fire, before they arrive to their full perfection. By reaſon of its moiſture it doth eaſily evaporate in the fire, and melts; carrying along with it whatſoever is not Gold or Silver, and therefore its ſelf is very eaſie to be refin'd: it is likeſt unto Gold in weight, and unto Silver in colour, being melted togther with them.

It not only facilitates the founding, and refines them, but ſeparates the Copper from them, as ſhall hereafter in its place be ſhewn; and therefore is the moſt neceſſary of all things, in the art of founding of Mettals, the whiteneſs of it ſhews the abundance of humidity, or impure Quickſilver, whereof it is compoſed, which the Chymiſts in ſeveral manner of ways do eaſily ſeparate from it.

It neither diminiſheth nor corrupts by the air or water like Iron, but rather increaſeth both in weight and quantity, as very good Authors do affirm, notwithſtanding others do ſay, that ſheets of Lead expoſed to the weather do waſte and conſume, and have been the ruine of many goodly buildings covered therewith. It is rarely found mingled with Gold, moſt commonly with Silver, and ſometimes with Copper. The Oar in which Lead is engendred is called in this Country *Soroches*, which for the moſt part is black, full of holes, and ſparkling; other pieces of it they call *Muertos*, becauſe it doth not ſparkle, nor

nor is ſpungy; others they call *Oques*, which in the language of this Country is as much as to ſay *Frayleſcos*, becauſe it is of the colour of a Friers coat: there hath been no Silver Mine diſcovered in all this Kingdom, wherein ſome Lead has not been found, in which regared it is needleſs to enumerate the ſeveral places that afford this Mettal, although moſt of the Mines in the *Chicas* have abounded therein, and therefore it is that they have founded ſo much Mettal in this Province. The Mines of *Andacava* are Lead and Silver alſo, but becauſe that Oar is not proper to be ſeparated by Quickſilver, and there is not wood enough near the place to melt it down; this Mine, which in my opinion is one of the richeſt in all the *Indies*, continues hitherunto yielding but a very ſmall profit. Below the mountain of *Potoſi*, as far as its ſhadow reacheth in that part called *Deſibicos*, there be many veins of Lead, with a very little Silver mixt in it; the like alſo there is within the ſhadow of *St. Chriſtoval de Oruro.*

CHAP.

CHAP. 32.

Of Tin.

THe Mettal which we call Tin, divers call white Lead; particularly they give it this name, that ſeparate Silver, and Copper, in which operation ſome Tin comes forth, as ſhall be ſaid in its place, which is known by its whiteneſs, and the noiſe it makes when one either bites or breaks it. Common Tin is begotten from the ſame principles as Lead is, but more fine and better purified, whence it becomes more hard and white, although from the ill mixture of its ſubſtance it is ſaid to ſtutter, and make a noiſe as hath been ſaid: it is the poyſon of Mettals, and makes them brittle that have the leaſt mixture of it, becauſe its incorporation with any Mettal alters the equal temper it had before, and impedes its ductibility; only it doth not infect Lead in this manner, becauſe the exceeding

ceeding great ſoftneſs and humidity thereof penetrates into, and incorporates with the ill tempered ſubſtance of the Tin, ſo that united together, they remain ductile and malleable. The veins of Tin are not found in every place that one hath a mind to; and yet theſe rich Provinces are not wholly deſtitute of them; there is a Farm of Mines named *de Colquiri*, not far from the hill of *St. Philip de Auſtria de Oruro*, which is famous for the abundance and excellency of the Tin, that hath been gotten there, wherewith they have furniſhed all this Kingdom, in following the veins whereof, as hath been adverti ſed before, many times they have met with rich parcels of Silver. Near unto *Chayanta* in the *Charcas*, there is another Mine, whence a few years ago they got abundance of Tin. Not far from *Carabuco*, a Village on the bank of the great Lake *Chucuito*, on that ſide towards the Province of *Larecaja* there be Tin Mines alſo, which the *Indians* wrought in the time of the *Ingas*, and the *Spaniards* continue to work ſtill;

ſtill; thoſe veins are very large, and rich in Tin, and many times amongſt it they meet with Silver; but all of it is mixed with Copper, which makes the Tin more ſightly and durable: the fame of theſe rich veins gave me the curioſity to ſee them, being deſirous that no Mines of theſe Provinces ſhould eſcape my knowledge and experience. In the mountain of *Pie de Gallo de Oruro*, there is much Tin, although few know it, and all neglect the working of it becauſe they find not the Silver there which they expect. One of the four principal veins of this famous mountain of *Potoſi* is called the Tin Mine, becauſe of the abundance of Tin that was at firſt found upon the ſuperficies of the Earth, and in digging deeper it all turned into Silver. And in the fields belonging to the pariſh of St. *Bernard*, where I officiate, a quarter of a league off, or a little more, there be rich veins of Tin, which upon my diſcovery, your Lordſhip went in perſon to viſit, whereby, as by other of your noble proceedings, you have given great encourage-

couragement to thoſe that are induſtrious in the working of Mines, which hath ſo eminently encreaſed the Royal revenue, and the riches of the people.

CHAP.

CHAP. 33.

Of Quickſilver.

QUickſilver is a Mineral very well known, of a liquid ſubſtance, and fluid like water; it is naturally viſcous, very ſubtil, and abounds in humidity, whence it obtains the qualities of being very heavy, and ſhining bright, and of being very cold, as it is generally thought, notwithſtanding ſome do affirm it to be very hot, by reaſon of the ſubtil effects and penetrating quality that it hath, whereby it runs through, not only fleſh, but the hardeſt bones; and alſo becauſe ſublimated Mercury (which ſubſtantially is nothing elſe but Quickſilver, though altered by the mixture of thoſe Minerals wherewith it is boiled and ſublimated

limated, and in like manner is reducible again to Quickſilver) is notoriouſly known to be poyſon, and hot in the firſt degree; but leaving the determination of this to thoſe that deal in ſimples, it is certain, that there is ſo great an affinity between the nature of Quickſilver, and that of other Mettals, that though it be none of them, yet it is convertible into any of them, becauſe as moſt Philoſophers hold, it is one of the principles of which they all are compounded, and moſt eaſily unites and incorporates with them; and moreover its very ſubſtance is tranſmutable into true Mettal, enduring the trials of the fire and hammer, as well as thoſe that come out of the Mine. *Raymundus* teacheth ſeveral ways how to turn it into Gold and Silver, in a book called *La Diſquiſicion Eliana*, there is taught a very perfect way how to make Lead of Quickſilver; and if one ſhould ſuſpect the credit of books, in theſe Provinces there be many eye witneſſes, that have Plate by them, which

which they have refined with their own hands by a Copel of Quickſilver, cured according to a receit given unto them; the which experiments take away all ſcruple of the poſſibility of its tranſmutation. There was very little uſe or conſumption of Quickſilver before the beginning of this new Silver age in the world, then they only waſted it in Mercury ſublimate, Cinabrio, or Vermillion, and the powders made thereof called *Precipitate*, which are alſo called in *Spain* the powders of *Juanes de Vigo*, which have been uſed to ſuch miſchievous purpoſes, that the world was ſaid to have too much of them, although in bulk and quantity then they had but little, but ſince it hath been uſed to collect the Silver together out of Oar, which is ground ſmall, (an invention which the Ancients had ſcarcely arrived to, and practiſed it but very little) it is incredible, how great a quantity is conſumed by the Founders of Mettals of this Kingdom: for if the abundance of Silver that hath gone out of this Kingdom,

hath

hath filled the world with riches and admiration; by it may be eſtimated the conſumption and loſs of Quickſilver, which after a moſt extravagant expence thereof at firſt, being now by good experience regulated within terms of moderation, is found to be equal in weight to the Silver extracted; and very ſeldom that the waſt is ſo little. They began to regiſter the Quickſilver that came to *Potoſi* upon the Kings accompt, in the year 1574; and from that time till 1640, there had been received of it upwards of 204600 *Quintals*, beſides a vaſt quantity irregularly brought in upon other accompts: to ſupply the exceſſive expence of this Mineral, God Almighty provided the famous Mine of *Guancabellica*, and in theſe Provinces ſubject to the *Charcas*, (of whoſe Minerals I have deſired particularly to inform your Lordſhip) there can be no want of this Mineral amidſt the great plenty it hath of all others; there are Quickſilver Mines in *Challatiri*, four leagues from this Imperial City; there be alſo of the ſame near unto *Guarina*: in the Provin e

of *Omaſuyo*, and not far from *Moromoro*, a Village of the *Indians*, ſix leagues from the City *Chuquiſaca*; a few years ago the *Indians* brought Stones very rich with Quickſilver, which by the violent death (as was ſuſpected) of the man that profered to diſcover the Mine, hath remained concealed unto this preſent.

CHAP.

CHAP. 34.

Of Artificial Mettals and Mettalliques.

ART alſo produces Mettals and Mettalliques, and in their fabrick aims at, and imitates the perfections of Nature. From a mixture of Tin and Copper is made Braſs for Bells, and for pieces of Ordnance, and for other uſes. They put a pound of Tin from four to eight *lib.* of Copper, according as the occaſion requires. The *Indians* underſtood this compoſition, and made uſe of it for their inſtruments of force, and for their Arms, as we do of Steel or tempered Iron, which they knew nothing of.

Latten is made of ſmall pieces of Copper put into large *Cruſiples*, cove-

red with powder of *Jalamina*, (which is a Semi-mineral of a yellow colour; there is of it near the Mine called the *Turc*, in the Province of *Carangas*, and alſo near unto *Pitantora* in the *Charcas*) upon the powder of *Jalamina* they ſtrew powder of beaten Glaſs to cover it, and keep in the reſpiration, and then they put fire to it, which alters the colour of the Copper, and makes an encreaſe of Mettal of eight *lib.* in the hundred weight.

For Looking-glaſſes they make ſeveral compoſitions, although the beſt is of two parts Silver, and one of Lead. Moreover they make by art, *Cinabrio*, Mercury ſublimate, *Precipitate*, *Pſorico*, *Eſmalte*, *Eſcoria*, *Diaphryges*, *Cadmia*, *Pompholix*, *Spodos*, *Flor de Cobre*, *Sueſcama*, *Cardenillo*, *Vermicular*, *Stommoma*, *Herrumbre*, *Aſcul*, *Albayalde*, *Sandix*, *Ochra*, *Greta*, *Purpurena*, and *Glaſs*.

Cinabrio is compounded of one part Sulphur, and two parts Quickſilver, well boiled, and ſublimated together in

in Glaſs viols, or in Earthen veſſels that are glazed. Mercury ſublimate is compounded of half Quickſilver, half Copperas, ground together extraordinary fine, and ſprinkling a little ſtrong Vinegar upon it as it grinds, that it may the better incorporate, then ſublimate it in Glaſs viols, as aforeſaid; it is alſo made with Allum, and many times they mingle a little Salt with it.

Diſſolve Quickſilver in *Aqua-fortis*, then ſet it upon a gentle fire, and let the humidity evaporate, and the Quickſilver will remain hard as a Stone, then grind it very ſmall, and ſet it again upon the fire in a Cruſiple, (or veſſel of Copper, if it can be gotten) and keep ſtirring the Quickſilver, until it be of a very lively red colour, and then take it off the fire for ſervice, and this is called *Precipitate*.

Pſorico is made of two parts of *Calchitis*, and one of *Greta*, ground and mingled together with a little ſtrong Vinegar, ſet it in a Muckhil for forty

days together, then take it out, and in a broken piece of a pot toſte it over the fire till it be very red.

The beſt *Eſmalte* is made of Allum, Copperas, and Saltpeter; it is ſuſceptible of all colours, as Glaſs is.

Eſcoria is that which worketh out of the Mettal when it runs, and ſwims upon the top of it like fat, (which we call droſs.)

That which remains in the botton of the Furnace, when they melt Copper is called *Diaphryges*.

Cadmia (although there be of it natural) is alſo that which ſticks to the walls of the Furnaces, principally wherein Copper is melted, of which they call *Bodrite*, that which is like unto *Cobas*; and *Stracita*, that which is like unto Potſheard; and *Placite*, that which looks like Bark or Shavings.

Pompholix is a mealy ſubſtance, and looks like Wool, as it ſticks to the walls, but diſſolves as ſoon as ones fingers touch it. It grows upon the walls as they melt Mettal. They vulgarly call it *Atutia*.

Spodo

Spodo is very little different from the *Pompholix*, only that it is more impure. It is found upon the walls where they refine Mettal.

Flower of Copper is made by pouring cold water upon the plates of Copper, as they come red hot out of the Furnace, which with the fume raiſe up little ſmall grains, which they ſweep off into a little Iron Fireſhovel, and ſo preſerve it.

La Eſcama del Cobre is that which falls off from the Mettal when it is hammered and beaten, and that which in like manner falls off from Iron is called *Stommoma*, (although this Greek name rather ſignifies Steel.)

Cardenillo is made by ſtopping viols of Vinegar with ſtopples of Copper, and letting it ſtand ten or twelve days before it is uſed.

If inſtead of Copper aforeſaid, they uſe ſtopples of Iron, it makes *Herrumbre*.

Vermicular is very like to *Cardenillo*; take one part of Whitewine Vinegar,

and two parts of ſtinking Urine, and pour it into a Copper Baſin or Mortar, and ſtir it about with a Peſtle of the ſame, until it grow thick, then put a twenty fourth part of Salt and Allum to it, ſet it in the Sun, until it coagulate and dry, and it will turn into the form of little worms, from whence it derives the name.

El Azul (or Blew) is made by covering a veſſel of ſtrong Vinegar (wherein a little *Almojatre* hath been diſſolved) with fine ſheets of Quickſilvered *Plantada*, full of ſmall holes, and putting it into a hot Muckhil, and after twenty days ſtanding, there rake out the *Aſcul* for uſe.

If in the former caſe one puts Lead over the Vinegar, it makes *Albayalde*.

Put *Albayalde* in a Spoon or Iron veſſel upon kindled Embers, and ſtir it until it looks very red, and then it is *Sandix*.

Ochra is yellow, it is made of Lead burnt until it come to that colour.

Greta

Greta is made in the refining of Gold and Silver, whereof hereafter.

Purpurina is of the colour of Gold, but of little endurance, and lasts not long. Take four or five parts of Tin, and as much Quicksilver, one part of *Almojatre*, and another of Sulphur, and grind them, mingle them in a Glass viol, and distil them, and the substance that remains in the bottom is the *Purpurina*.

In the last place comes the most curious production of Art, and that is the making of Glass. Take two parts of transparent Sand, or powder of Stones, which dissolve in the fire; one part of Nitre, or Saltpeter, or Salt of *Sosa* (which they call the herb of Glass) clear and purifie it with the mixture of a little powder of a Loadstone.

Another receipt. Take two parts of Ashes, and one of the Sand aforesaid, with the powder of Loadstone, and give it a fitting heat in the Furnace.

CHAP.

CHAP. 35.

Of the Colours of all Minerals generally.

THat thoſe who want experience may the more eaſily know the Minerals that come to their hands, and that by their eye-ſight (the trueſt informer of all the ſenſes) they may know what they meet with in the bottom of Mines, I ſhall reduce all ſorts of Minerals unto Colours, as to a *Genus* moſt familiarly known; ſome ſorts of *Gretæ*, (or Fullers-earth) *Allum*, *Amianto*, the *Arabick* Stone, the *Meliti*, the *Gallatiti*, (or the Milk Stone) *Alablaſter*, the Diomond, Silver, Quick ſilver, Tin, and Marble are white of colour; *la tierra Pingiti*, *Jeat*, *Sori*, *Melanteria* are black; of an aſh-colour are the *Eritrian*, and the *Melian* earth; of blew is the

the Saphir, the Ciano, the Turky Stone, the *Lapis Laculo*, and *el Cibairo*; of green colour is the *Emerald*, the *Praſma*, the *Chriſocola*, or *Atincar*, ſome ſort of *Greta*, and Vitriol, or Copperas: of the yellow colour is Gold, the *Ochra*, the *Chriſopacio*, the *Chriſolite*, and *Orpiment*; of red the *Ruby*, the *Granatte*, the *Balax*, the *Cornelian*, the *Sandaraca*, *Corral*, *la Piedra*, *Seiſſile*, the *Hematite*, or Blood Stone, Copper, *Minio*, (or Vermillion) the *Lemnian* earth, and *Almagre*; of purple colour is the *Jacint*, and *Amathiſt*; of a clear blew the *Jaſper* called *Boria*; of a greeniſh blew the *Cardenillo*, and the *Armenian* Stone, or *Cibairo* are of this colour; (and ſo the Painters call the Colour which they make of this Stone, a verdured blew) of a white inclining to a red is the *Afrodeſiaca*; of a red that is whitiſh is the *Xanto*; between black and red is the *Batrachiti*; of a black inclining to purple is the *Alabandico*; of a yellowiſh white is the *Topas*.

There be Minerals of any one ſingle colour,

colour, either black or white, or mixed together, as the *Agates*. The *Apſito* hath red veins diſperſed upon a black field, and contrariwiſe the *Naſomonite* hath black veins upon a red field. The *Heliotrope* in his fine green ſubſtance hath veins of the pureſt blood; and in *Saphires* and *lapis Lazuli* are ſeen very reſplendent Gold. Two veins, one white, and the other red, run quite through the ſubſtance of the *Egitilla*.

The *Eupatalo* is of four colours, namely, Blew, fiery Red, Vermillion, Pippin colour.

The *Orea* alſo is wont to be found of ſo many colours, namely, red, green, white, and black.

CHAP.

CHAP. 36.

Of the Faculties or Vertues of Minerals.

I Shall finiſh this Treatiſe with a brief relation of the medicinal Vertues that are found in Minerals, more than what hath been already mentioned, that thoſe that poſſeſs them may know how to benefit by them when the occaſion ſerves. Some Minerals work by their occult eſſential properties, (or ſpecifical form) others by the mediation of their Elementary qualities, contrary to thoſe of the diſeaſe. Of the firſt ſort ſome are oppoſite unto poyſon, and others to other ſorts of infirmities; and of thoſe that reſiſt poyſon ſome cure the Plague, as the *Emerald*, the *Lemnian* and the *Armenian* earth; others are good againſt one ſort of poyſon only, as

as the *Saphire* drunk inwardly is againſt the biting of Scorpions. Sulphur, Nitre, and Copperas are good againſt the venemous muſhroms: Salt uſed plaiſterwiſe, is good againſt the biting of Vipers and Scorpions, drunk inwardly is good againſt the poyſon of *Opium* and Toadſtools. Of thoſe that cure by occult quality, ſome ſtop the blood from paſſing to a particular part of the body, as the *Hematite*; others corroborate and fortifie the ſtomach, when they are hung upon it by help of a ſtring going about the neck, as doth the true *Jaſper*: others tied to the left arm reſtrain abortion, as doth the Eagle-ſtone, which the *Greeks* call *Ætites*, and if it be bound upon the left muſcle, it produces the quite contrary effect, as alſo doth the *Jaſper*: others purge groſs humors; as doth the Loadſtone; others melancholy, as the Stone-*Armenia*, or *Cibairo*; others provoke to vomit, as doth the aforeſaid *Armenia*, *Chryſocola*, *Copperas* and *Precipitate*.

Amongſt thoſe that work by their Elemen-

Elementary qualities, (although generally all Minerals are drying) ſome heat the body, as do *Allum*, *Copperas*, *Calchitis*, *Miſi*, *Sori*, *Melanteria* and *Cardenillo*; others cool it, as to the *Eritrian*-earth, *Stibium*, (or *Antimony*) *Albayalde* and *Greta*, or *Lithargirio*. Others with the ſecond qualities which they poſſeſs, ſoften hardneſs, as doth the *Agate*, becauſe it participates ſo much of the *Betune*; others contrariwiſe will harden ſoft parts, as doth the hard *Lead* and *Eſtibium*: ſome open the pores of the skin, as *Nitre* and the ſcum thereof: others ſhut the pores, as doth the *Samian*-earth, and all other Earth that is ſlimy and tough. Some diſſolve Warts, and Biles, and Kernels in the body, as the *Piedra*, *Molar*, and the *Marcaſita*; others heal wounds, as the *Calchitis*, the *Miſi*, and *Allum*: others corrode the fleſh, as doth the powder of the Stone *Aſia*, and *Copperas*, and *Cardenillo*: ſome make the fleſh putrifie, as *Quicklime*, *Orpiment*, *Sandaraca*, and *Chryſocola*. *Mercury* ſublimate, *Orpiment*, *Sanda-*

Sandaraca, and *Quick-lime* are poyſon, becauſe they corrode and putrifie the bowels; ſo alſo is *Morter*, *Albayalde*, and *Talco* calcined, becauſe obſtructing the paſſage of the ſpirits, they choak one.

FINIS.

THE SECOND BOOK OF THE ART of METTALS,

Wherein is

Taught the Common Way

OF

REFINING SILVER

BY

QUICKSILVER.

WITH

Some New Rules added for the better performance of the ſame.

Written in *Spaniſh* by *Albaro Alonſo Barba*, Maſter of Art, Curate of St. *Bernards* Pariſh in the Imperial City of *Potoſi*, in the Kingdom of *Peru* in the *Weſt-Indies*, in the Year, 1640.

Tranſlated in the Year, 1669.
By the R. H. Edward *Earl of* Sandwich.

London, Printed for *S. Mearne*, Bookbinder to the Kings moſt Excellent Majeſty, 1674.

most of the annotations in
this 2d. part of Bowditch are
by A. Wurtz the discoverer
of sodium Amalgamation

The Second Book of the Art of Mettals.

CHAP. I.

That no man ought to be employed to Refine Mettals, but he that hath been examined and Licenſed by Authority.

THe abundance of Minerals, wherewith God hath enriched almoſt all the Provinces of this new world (ſerving himſelf thereof as a Medium, to other high deſigns of his Divine Providence) hath been ſo great, that it is ſcarce poſſible to be believed. The Mountain and Imperial City of *Potoſi*, having already

yielded, between four and five hundred Millions of Peeces of Eight, a quantity ſufficient to make ſuch another hill of Silver; it is hard to form a conception equal unto ſo exorbitant a heap of Riches; but the better to help our imagination therein, know that, if the ground were covered with Peeces of Eight, laid as cloſe to one another, as is poſſible, they would take up the ſpace of ſixty Leagues ſquare, allowing five and twenty Peeces of Eight to a *Vare of Spain* (a Vare of *Spain* is 33. *Engliſh* Inches) and five thouſand Vares to a *Spaniſh* League. This glut of Riches, hath been the reaſon why they have not applyed the care that was requiſite, to prevent loſs and waſte in the Refining of Oar, which ſpeaking with moderation, hath been the loſs of many Millions, both for want of giving it due Law, the nature, and difference whereof, they did not underſtand; and ſo proceeded by chance, and without good ground, neither knew they well, what quantity of Plate the Oar would yield. And laſtly, they deſtroyed unneceſſari-

neceſſarily abundance of Quickſilver, whereof hath been already conſumed in this Imperial City, more than 234600 Quintals; I know not whether this neglect ſpeaks greatneſs of mind in the inhabitants of this Kingdom, that they deſpiſe to pick up Crums, which nevertheleſs were ſufficient to ſatisfie the hunger of many Kingdoms of the other world; or whether it condemns the careleſsneſs of ſo wiſe and well governed a Commonwealth, that they have not uſed all poſſible means to put a ſtop to ſo unneceſſary a Prodigality. The firſt and fundamental remedy whereof, is in my opinion, that the Mettals be Refined by one that underſtands the Art, and is Authorized thereunto by Publick Licenſe, after ſtrict examination of his ſufficiency, which is required before the admiſſion unto divers callings in the Commonwealth, without compariſon of much leſs importance than this is. The Maſters of Refining Works have taken no Care at all in this matter, becauſe how negligently ſoever they Refine their own Oar,

they loſe nothing, but have all the Silver, either in the Plates, or amongſt the Droſs; and that which they Refine for others, yields more profit to theſe Refiners, the worſe it is wrought, becauſe more remains with them in the Droſs; but both theſe are ill reaſons to proceed upon, becauſe the making full profit of their own, muſt coſt a double labor, and the ill Refining other mens, redounds to a Publick prejudice.

CHAP. II.

What quantities, and what kind of knowledge a Refiner ought to have.

IT is a very great Truſt that is put into the Refiners, the whole Riches which this moſt proſperous Country produceth, being put into their hands without account, or any obligation of the quantity they are to return; their word and honeſty only, without reply, or appeal from their ſentence, is the only ſecurity of the truth, of what the

Oar

Oar hath yeilded; and it had need be a ſtrong ſecurity, when the violent incitation of private intereſt is to deceive. He therefore that liveth continually amongſt theſe occaſions, had need be well furniſhed with the honor of a Chriſtian, leſt having his fingers perpetually kneading in the paſte, a good deal do not ſtick unto them; there ought to be a great deal of circumſpection in chuſing this Officer, for no miſchief that hinders the Refining of Oar, or extravagant conſumption, or loſs of Quickſilver, can occaſion ſo great prejudice as a Refiner of a wicked Conſcience.

Neither yet is it alone ſufficient, that his Manners be good, if he want the knowledge neceſſary to the Art of Refining. He ought to know all ſorts of Mettals, their qualities and differences, which of them are moſt proper for Quickſilver, and which for Melting, if there be conveniency for it. He ſhould know the diſeaſes alſo that infect Mettals, and the way of clearing them; the accidents of Quickſilver, and the ordinary way

of Refining in great and in little; and in no caſe let him be admitted for a Refiner, that doth not well underſtand how to make the leſſer Enſay by the Fire, of Oar that is ground to powder, before the Mettal be incorporated together, that ſo he may know certainly how much Silver ought to be gotten out of that Oar; and he ſhould never give over making tryals, untill he hath obtained it. The want of this one care hath coſt this Kingdom abundance of Mony, and is of great prejudice to it, even at this day; two experiments whereof I ſhall relate, which have paſſed through my hands, that you may the better eſtimate the importance of this advice: A few years ago, when I lived in the Province of the *Lipes*, in a Pariſh which they call *Xauquegua*, a Miner had wrought a Vein, out of which he drew a quantity of very Rich Mettal, although he knew it not; he Enſayed it by Quickſilver, and found it to contain four or five Peeces of Eight the Quintal, and at that rate Refined it all by the great; at length they deſerted

ſerted the Mine for being of little profit: Afterwards an *Indian* carried me to the place, I found Mettal in the Moulds that were drawn out, and alſo in the Vein which had not been much wrought, I Enſayed it by the fire, and found it to contain 900 Peeces of Eight the Quintal, although by the ordinary way of Quickſilver it yeilded but four or five; I diſcovered this Vein to the Magiſtrates, calling it by the name of *Nueſtra Senora de Begomia*; they built a Mill preſently near it, and abundance of Miners flocked thereupon, and have gotten thence a great quantity of Silver.

In the Mountain of *Santa Juana*, out of the Mine of *Berenguela de Pacages*, they got a Mettal like unto *Soroches*, which by the ordinary Enſay with Quickſilver, appeared ſcarce to have any Silver at all in it; whereupon the Miners utterly deſerted it, untill a Prieſt a Friend of mine, ſent me ſome peeces thereof unto *Oruro*, which I Enſayed, and found them to contain 60 Peeces of Eight the Quintal; by my advice he dug a great

great quantity of that Mettal, being laughed at by the Neighbors whileſt he was at work to ſo little purpoſe (as they thought) but afterwards much more envied by them for the great riches he had gotten.

CHAP. III.

Of the knowledge of Mettals, and the diſferences there are of them.

IT is almoſt impoſſible to teach thoſe, that have not been acquainted with Mettals, how to know them by the ſight, becauſe there is ſo great diverſity of them; that there is ſcarce any ſtone in one Mine, that reſembles ſtones of the ſame Mettal in another Mine; no nor oftentimes of the ſame Mine it ſelf. Nevertheleſs the Miners reduce theſe differences unto three general heads, which the *Spaniards* call, 1. *Pacos*, 2. *Mulatos*, and 3. *Negrillos*. *Paco* in the general language of this Country, is as much as to ſay of a Red colour, and

and ſuch more or leſs are the Stones, which they call *Metal Paco*, although in *Berengula de Pacages*, they call the Green Mettals of Copper by the ſame name, which alſo in theſe Provinces they give to Mettal of any colour, in contra-diſtinction to Mettals, that ſhine like Steel or Glaſs, and another ſort which they call *Negrillos*. *Mulatos* is a colour between the *Pacos* and *Negrillos*; and in the Mines, Mettal of that colour is produced in the ſame order; it is of a Brown colour, and ordinarily accompanied with ſome of the *Margagita*; there is leſs of this Mettal, than of the two other ſorts. The *Negrillos* have been diſcovered by, and take their name from their colour, although all Black Mettals are not comprehended under that name. *La Tacana* a rich Mettal, and uſually Black, although there be of it Grey and Aſh-coloured, which they call *Lipta* belongs to the *Metals Pacos*, as alſo doth the Lead (for ſo they call the Silver Oar) which oftentimes is Black, Grey, Aſh-coloured, Green, White, and Orange Tawny, which they

they call *Suco*; and this laſt year in the Mountain of *Potoſi*, there was found of it, of a bright lively Cinamon colour, or very fine Vermilion, a thing which hath not been ſeen in any other Mine. The *Soroches* might conſtitute a fourth order of Mettals, but I agree with the opinion of others, that would have them ranked under the name of *Negrillos*, to which alſo belongs the *Roſicler*, the richeſt Mettal that nature hath produced in the form of a Stone; it is ſhining and brittle, and the powder of it beaten finer with any hard thing, is of the colour of pure blood, it is very like unto *Cinabrio*, or that Vermilion which is made of Quickſilver and Sulphur, which gives a good hint for the finding out of divers other greater ſecrets. *Cochico* is alſo of the ſame kind a very rich Mettal, Maſſy, but neither ſo brittle nor ſpungy as the *Roſicler* is, but it is more full of Lead, and is not ſo eaſily beaten to powder, nor gives ſo perfect a blood colour.

Soroches, *Tacana*, *Polvorilla*, *Roſicler*, *Cochico*, and *Negrillos*, are diſtinguiſhed

one

one from another, in the manner following.

The *Soroches* are black, or Aſh-coloured, either ſhining, or without any luſtre (which they call dead Oar of Lead) and commonly contains ſome Silver.

The *Tacana* is Silver Oar cloſe compacted, of a Black colour, without any ſhining at all.

Polvorilla is *Tacana*; not congealed, nor ſtony, but is rich in that Oar they call *Pacos*, but in the *Negrillos*, not ſo much, by reaſon of the mixture of Copper, that it hath.

The *Roſicler* and *Cochico* is Silver Oar with that ſame Varniſh, which hides its own proper colour, and ſhines, whereby it differs from the *Tacana*. That which predominates in the *Negrillos*, is Copper, either actual, or elſe Vertual in the Copperas, wherewith it abounds; it always contains Silver more or leſs, and is uſually accompanied with the *Margagita*.

The Black Mettal which feels like Lead, and is ſmooth (which makes as it were

were Leaves of Trees or Feathers) contains a great deal of *Alcohol*, or Antimony (which in ſome parts they call *Matacote*) and but little Silver. Thoſe *Negrillos* which have luſtre like poliſhed Steel, or Looking-glaſs, and are therefore called *Eſpejado* and *Acerado*, are the richer the nearer they approach unto the *Roſicler* and *Cochico*.

CHAP. IV.

Of the ſorting of Oar, and the proper manner of Refining each of them.

THe skill of extracting all the Silver, out of any Oar, begins to be exerciſed in the picking and ſorting of the Oar together; the want of care in ſorting Oar from Stones, that have no Oar in them, as alſo the Oar of one ſort of Mettal from another, hath occaſioned much damage; the leaſt inconvenience hath been in the uſe of Quickſilver, a quantity whereof is loſt together with grinding, and other charges about that which is no Mettal; the greater inconveni-

venience hath been, where there was Mettal, the failing to get out all the Silver, becauſe they have jumbled together Oar of ſeveral ſorts, and uſed but one manner of Refining, whereas thoſe Mettals require a different way of handling and time. To Enſay that Mettal by Quickſilver, that requires the fire, is to deſtroy it; to put that Mettal in the Furnace, which is not to run, is to endamage the Mettal, and to get no profit at all; and although the ſeveral Oars be properly aſſigned, ſome to the Quickſilver, and ſome to the fire, yet they have their differences of being eaſier or harder to be Refined according as they concur, or differ in the remedy, that is neceſſary to be uſed for that purpoſe. The Oar, which they call *Pacos*, that ſhines or ſparkles not at all, is proper for Quickſilver. The *Tacana* alſo may be refined by Quickſilver, but becauſe it is ſo very rich Oar, leſt it ſhould not be clean extracted, but part of it remain in the Droſs, it is better to melt it in a bath of Lead. That Oar which containing Silver in it, yet they

they call by the name of Lead Oar, if it be over groſs, will neither grind well, nor cleave faſt to the Quickſilver, and is beſt to be melted together with the *Tacana*.

The moſt proper way of dealing with the Oar, they call *Machacado*, is the Hammer, the *Soroches* need the fire, the *Roſocler* and *Cochico* are to be melted like the *Tacana*; the *Negrillos* require both fire and Quickſilver, for they prepare all the Oar of that kind by the fire, for the Quickſilver by that means collecting the Silver, either burnt, or boyled, as ſhall be ſhewed hereafter.

CHAP. V.

How to know the ill qualities that infect the Oar, and how to purge them away.

OF various and very different qualities are the ſubſtances that Nature hath produced in the Veins, that contain the Oars of Mettals, whether they

they be Abortions which the covetouſneſs of Mankind occaſions by tearing the Oar out of the bowels of the Earth before its full time, which otherwiſe would come to be Mettal in perfection, or whether it be excrementious ſuperfluities of the generation of all ſorts of Mettals; they be uſually called Semi-minerals and are Salts, Allum, Copperas, Sulphur, Orpiment, Sandaraca, Antimony, or Alcohol, Brimſtone, both White and black, and Margagita.

Scarce any Oar is gotten that doth not participate of one or more of theſe ill companions, all of then being hindrances to the extracting Silver out of the Oar, whether it be by the Fire or Quickſilver; thoſe that partake of Copperas, of which ſort are thoſe they call *Copaquiras*, are mortal enemies of Quickſilver, which they conſume and ſcatter, and that ill condition is heightned, if Salt be mingled with it, which makes it penetrate more violently, and ſuddenly; the learned *Raimundus* knew this antipathy very well, and hath left it diſcovered to us in writing; and

thoſe that deal in Mettals daily have it in their hands, and yet take no notice of it; this is that, which eats up the Quickſilver, and diſſipates the Caxomes of Mettal, and hath occaſioned ſo great an expence of Mettals, namely, Iron, Lead, Tinn, and Lime. Whoſoever hath a mind to make experiment hereof, let him mix a little Quickſilver with Copperas well ground, and water, and he ſhall ſee in an inſtant all the Quickſilver diſſolved and loſt; eſpecially if he put a little Salt to the former compoſition. This will be no wonder to thoſe that know *Mercury* to be Quickſilver, and that the great change in its ſubſtance, is cauſed by Copperas and Salt, wherewith it is mingled, and then ſublimated in the heat of the Fire; this is the greateſt poyſon to the refination by Quickſilver; although ſometimes it is uſeful, and ſerves like Treacle to thoſe ſorts of Oar, which have uſe of it, as ſhall be ſhewed in it's place hereafter.

This inconvenience is found out, and remedied, with very much eaſe; grind a lit-

a little Oar, and put ſome fair water to it, heat it the more the better, ſtir it well, and then let it ſtand a while, then pour out the clear water into another veſſel, leaving the Sedement behind undiſturbed, prove it by the taſte, and you ſhall well judge what mixture it hath, by it's dry or ſoure taſte; and whoſoever deſires an occular demonſtration of this, let him ſet the aforeſaid water upon a gentle Fire, ſimpering untill the moyſture be conſumed, and he ſhall ſee with his eyes; in that which remains at the bottom, either Allum or Copperas. Bathe the Oar in the manner aboveſaid, ſo often as ſhall be neceſſary, untill the water, that comes from it be ſweet, and without taſte, or that ſtirring it with a bright peece of Iron, it doth not ſtain it with the colour of Copper, and then that Oar is perfectly cleanſed and ſecure, not to hurt the Quickſilver, when it is put unto it.

Although Sulphur, Betun, and Antimony do oftentimes diſcover themſelves unto the ſight, yet a better way

of finding them out, is by the ſmell, which comes from the Oar, when it is well burnt in the Fire; but for fuller ſatisfaction herein, they may be diſcovered and cleared from the Oar in the manner following.

Grind the Oar ſomewhat groſs, and put it in an earthen Pipkin that is not glazed, that hath a great many ſmall holes in the bottom of it, and ſtop the mouth of it cloſe, then fit a Veſſel of water round about it, in ſuch manner as they do, when they clear the Pine Apples from Quickſilver, and put fire under the ſame Baſon of Water, wherein all the ſmoak that goes out of thoſe little holes will ſettle, and there you ſhall ſee congeal'd and ſwimming upon the top of the Water, the Sulphur, Antimony or Betun, each in his proper form. When the Oar will ſmoak no longer, it is a certain ſign that it is clear of thoſe impediments, which although they be not direct enemies to Quickſilver in raw Oar, yet the Varniſh which they give to the ſilver, hinders the Quikſilver from laying hold of it, and uniting

uniting it together; and by the brittleneſs and aſperity like Glaſs which thoſe Oars have that participate of the impediments aforſaid, they cut and divide the Quickſilver when they are ſtirred together into ſmall White pins heads as it were, which the *Spaniards* call *Lis*. It is neceſſary to burn this ſort of Oar, although it be good to melt them firſt before they put them into the fierce Fire, becauſe without that preparation the Silver will all be turn'd into droſs.

The *Margagita* that is in Oar, diſcovers it ſelf but too plainly to the eye by its weight and ſharp glaſſie quality, it divides the Quickſilver into ſmall *Lis*; when they ſtir them together, thoſe ill qualities are taken away by the Fire, if you burn it therein untill its gloſs and ſhining be gone, it doth moſt hurt unto that Oar which they melt, the abundance of Sulphur whereof it is compounded making a great ſcum upon the face of the Liquor, which much ſtifleth the fundition.

CHAP. VI.

Of the Grinding of the Oars of Mettal.

THe Grinding of Oar is a preparation abſolutely neceſſary for the getting out of it, the Silver, or Gold that it contains by Quickſilver, and the fineneſs of the Meal is a principal means of ſhortening the work and clear extraction of the Plate: one fault amongſt many, which the blockiſhneſs of this Country has committed, hath been to make the meal very groſs, or to leave many lumps therein; there needs no great pains to prove that the Quickſilver attracts or incorporates with it ſelf that Silver which it immediately touches; ſo that the Mettal which is in middle of any lump remains in the ſame condition it came out of the Mine, and has more or leſs loſs in it, according to the richneſs of the Original Oar, and according to the richneſs or courſneſs of the Meal. I have made divers tryals of Grinding thoſe lumps over again, and find

find that in them remains, when leaſt, the ſixth part of what is in the Oar when it is firſt taken out of the Mine, which is very conſiderable in a whole years work, and incredible in the great quantity of Mettals that have been already gotten. *Agricola* after having taught the way of Grinding & ſifting of Mettals which they now practiſe in the Mills, teaches a way how to reduce it to extraordinary fine Flower in a kind of horſe Mill with Stones like Mill ſtones: he thought this pains to be neceſſary, although to an end different from that refining which we now practiſe, wherein it is clearly and indiſpenſeably neceſſary. I learn't the manner of doing this from one that had gotten a great deal of mony by Grinding the lumps over again, although he did not take out all the Plate, becauſe he ground them in an ordinary Mill, whoſe Hammers could not beat it ſo ſmall as it ought to be, for the lumps either ſlip'd away from under the Hammer, or being uneven one defended the other from the ſtroke; to have good Sives, and care

in lifting them up is of great importance to this matter, but not a full remedy, after the waſhing of the Oar, eſpecially if it were of rich Mettal is the beſt gathering up of lumps to regrind. If they burn the lumps, they will yield more Flour, becauſe ſome of the lumps will calcine and be ſmoother, and others will ſwell and grow more ſpungy, whereby the blow of the Hammer will have better effect upon them. I do uſe another way of preparation by boyling, as ſhall be ſhewed hereafter, which I do hold more proper to be uſed in all refination by Quickſilver; put the Oar ground and ſearſed into a skillet in like manner (as if it were already incorporated with Quickſilver, and ready for waſhing) then pour a ſufficient quantity of water upon it, ſtirring it with a Ladle or hand-mill, whereby all the fine will ſwim à top, and the groſs and ill ground will ſink to the bottom; take away the fine with a ladle, put it in the melting pot and boyl it, grind the groſſer part again in a Mill or a Morter untill it become all meal; If I deſire to

make

make a Xoves of the fine ſort after the ordinary manner of refining, I muſt mingle ſome pure ſand therewith, that it may ſwell and want the Inconveniencies which that kind of Oar uſeth to be accompanied withall.

CHAP. VII.

Touching the Burning of Oar.

THe Burning of Oar is uſeful for two purpoſes, *viz.* 1. That it may Grind the better. 2. That it may be in better diſpoſition for the Quickſilver to lay hold of, and incorporate it ſelf with the Silver that is in it. The reaſon of the firſt is plain, and the experience of the latter, ſince they order all the Negrillös or blacker Oar in that manner, but generally not underſtanding the reaſon thereof. And certainly in all the art of refining nothing is practiſed ſo much by gueſs or chance, and without knowing the ground of it, as this is. Refiners will ſay, they burn the

the Oar to clear it of ill qualities, not apprehending that thence it will follow that by fire enough they ſhould quite cleanſe and purifie it, whereas the contrary is found by experience, and that according as they burn it more, the worſe conditioned is the Oar, and needs the help of ſome other material to prevent, that all the Silver and Quickſilver too, that is in it, be not loſt.

There is but one enemy naturally oppoſite unto Quickſilver (as hath been ſaid already) and that is the Copperas, and the fire is not only uſeleſs for the vanquiſhing that, but on the contrary it multiplies and encreaſes it; and if the Oar have no Copperas in it when it is put into the fire, the fire will beget and produce it, as may eaſily be ſeen by experiment. In the Burning of Negrillos (or black Oar) in which the fire encreaſes the Copperas ſo much, that it is neceſſary to uſe other materials in the burning of it to repair that damage, although if they had throughly underſtood this matter, they might have

have cheaper and eaſier done it, by waſhing the Oar (as I have ſaid before) untill it were cleared of all the Copperas; The ignorance of which remedy hath been the occaſion of great waſte and loſs.

Other diſeaſes of Oar do not directly injure the Quickſilver, only by the Varniſh and Glaſſie quality which they give, they hinder the Plate and Quickſilver from incorporating and making a Maſs together; and therefore the rule in this caſe is to burn the Oar ſo long untill it change colour and loſe the luſtre and ſparkling that it had. To know the Oar that of neceſſity muſt be burnt (if it be to be Refined by Quickſilver) the luſtre and ſhining aforeſaid is a certain ſign. The fire will not prejudice that Oar they call Pacos, and if it have any mixture of the aforeſaid impediments, it muſt of neceſſity be burnt.

CHAP.

CHAP. VIII.

Touching the dammage that reſults from the burning of Oar.

MEn having hitherto proceeded by chance as it were, and without certain knowledge of the quantity of Silver contained in a peece of Oar have judged him the beſt Refiner that has gotten moſt Silver by one operation, leaving it doubtful whether any more or no were to be gotten out of the Oar, eſpecially in the Negrillos and Oars that cannot be excuſed from burning. This doubt has been greater, there being leſs certainty here where there ought to be much the greater; and from hence men have found no leſs inconvenience by miſtaking on the one hand, than on the other; wherefore this manner of preparation hath been eſteemed, as dangerous as profitable. With skill and curioſity one may obſerve many wonders of Nature in the burning of Oar, the parts of Iron and Brimſtone, which commonly

monly accompany the Oar, when they come to the fire are converted into Vitriol or Green Copperas; this afterwards is turned into fine Copper; again, the Copper calcined, diſſolves in water like ſalt, the which ſtrain'd and evaporated by a gentle heat coagulates into another kind of Vitriol or blew Copperas, like unto that which they call the ſtone *Lipes*, and is of admirable Virtue for the turning of almoſt all Mettals into Copper, the purity of Silver it ſelf does not excuſe it from being ſubject to ſuch a metamorphoſis, for if the Oar have in it any Allum, Copperas, Saltpeter, or Nitre by the help of the fire, they will calcine the Silver ſo, that it will diſſolve in water, and not be lay'd hold on by Quickſilver without uſing ſome new Artifice, and even Salt alone as it grows incorporated in the Oar, or mingled with it in the fire is capable of producing the ſame effect as ſhall appear evidently in the following experiments.

CHAP.

CHAP. IX.

Experiments which prove the damage by the burning of Oar if they be not known and remedied.

GRind a peece of Oar that has Copper or Iron in it, and by the direction of the fifth Chapter of this Book, try if there be any Copperas in it, and if there be, clear the Oar of it by washing of it, and after it is dry burn it well, and put it into water again, and you shall see much Copperas anew produced by the fire; the Refiners daily do this with their hands, although they take no notice of it; and although this experiment be sufficient to satisfie every body, yet for greater confirmation of this secret to grind Oar of Copper or Iron, and melt it into thin Plates, and grind some Sulphur, and in a Crusiple or Earthen pot unglaz'd, put a lare of that Sulphur, and upon that lay one of the Plates, and proceed in that order as far as you think fit, stop the

the mouth of it well, that it give no vent; and after it is dry, put it between red hot Coals in ſuch manner as they encompaſs it round about, but do not touch it; after the Cruſiple is ſufficiently hot, put the fire neerer to it, and at laſt make the fire fierce; but not ſo much as to melt the Plates; then take it out and the Plates will look black and be brittle, grind them very fine, and put the fourth part of their weight of beaten Sulphur, together with them into a peece of broken pot or earthen Baſon upon Embers, heat them ſo as you heat an Enſay of the black Oar, ſtirring them continually untill the Sulphur have left ſmoaking, and the oftener you repeat this the better; laſt of all being well beaten and hot, or elſe the water hot, and after a little time boyl the water, and if it colours bright Iron of a Copper colour, that the water evaporate by a gentle fire, untill it begins to be covered with a kind of Cream, then take it off and ſet it a cooling, and it will congeal into moſt beautiful tranſparent Copperas, Green if the Plates were

were of Iron, or blew if the Plates were of Copper.

Diſſolve this Copperas or Stone *Lapis* in water, and put Steel or Iron to it, and it turns into moſt pure Copper, ſmooth, and ſoft as gold after it is new melted. If one melt Lead or Tin, and pour it in ſmall drops upon the face of that water, the whole ſuperficies will be turned into Copper, and the oftner it is repeated, the greater quantity of the Lead will be transformed untill no Lead remain.

Tin is very eaſily turned into braſs. I was the firſt which in the Province of the *Lipis* found out and publiſhed theſe ſecrets. Alſo Silver is turn'd into Copper if it be made very fine, and with much Salt (an experiment which ought to be as highly eſteemed by the Refiners, as the turning Copper into Silver) *Aqua fortis* is a common thing, if it were not, its vertue would be held miraculous, it turns Silver into Water, and calcines it into duſt; it is made of Copperas or Allum and Salt-peter, the Spirits that flye from any of theſe ſubſtances, when

Oar

Oar that contains them is caſt into the furnace, works the ſame effects: with beaten Brick and Salt eſpecially of the rock is made a Cement, wherewith they ſeparate Silver from Gold; theſe two attract the Silver to themſelves and with the heat of the fire only calcine it; in the burning of Oar they have the ſame effect; the Silver being calcin'd in either of the aforeſaid manners if it be put into water diſſolves in it like Salt, and the Water looks white as milk, and will ſpot ones hands or nails if you touch it, notable ſigns of *Aqua fortis* in Silver, whereunto Refiners ought to have great regard, that it deſtroy not their Silver; theſe inconveniencies there are in the burning of Mettals, beſides another which anon ſhall be diſcovered, and though the proper way of avoiding them is caſting or melting the Oar which renders uſeful, not only that Mettal which is precious, but alſo the baſer ſort, as ſhall be ſhewn in its place, nevertheleſs becauſe all places do not afford conveniencies for melting down Oar, nor all Oars contain

Mettals rich enough to pay the coſt, let the aforeſaid inconveniencies when they happen be remedy'd according to the rules which ſhall be ſet down hereafter, although it be impoſſible to prepare Oar without burning ſo as to yeild that quantity of Plate it did by Quickſilver, as ſhall be ſhewn where the refination by boyling is treated of.

CHAP. X.

whether the Oar ought to be burnt in the ſtone or in the meal.

THey uſe to burn Oar in the Stone or in the Meal, and burning it in the Meal, they better underſtand the nature of the Oar, for taking care to ſtir it well about, and mix it equally in the Furnace, taking out a ſmall quantity, and putting Quickſilver and Salt thereunto in a ſhort ſpace of time; by the diſpoſition of the Quickſilver you ſhall quickly know what the Oar is, whether it begin to grow like Lead or no,

no, and whether the Lead be groſs or fine, or whether there be need of more materials or no, or whether to continue, or ſtop the burning of it, according as every Refiner by his own experience hath found to ſucceed beſt with it out of that Oar which is burnt in the ſtone, cannot be choſen this equality, becauſe the force of the fire cannot be equally communicated to ſtones in a divers ſcituation and of different bigneſs; for it is clear that the ſmall ſtones are ſooner heat than the greater, and thoſe that are in the Center of the Furnace, ſooner than thoſe that touch the ſides; but this manner of burning is ſubject to leaſt damage, beſides that it facilitates the grinding of the Oar.

It is a great error to burn Oar already grownd by reverberation, becauſe the fierceneſs of the fire; burn the Sulphur or Betun which it contains, and ſuffer it not to diſcharge it ſelf by little and little, but obligeth it to mingle it ſelf with the Silver, and altogether to turn it into droſs; moreover the force of the flame raiſes up the ſetled parts of the

Silver when they ſtir the Oar, and turning it into ſmoak, blows it out of the Furnace. The moſt ſecure way of burning Oar already grownd, is to do it by a Toſtadillo (or preſerving Pan) made in the faſhion of a Furnace, as ſhall be directed hereafter, and becauſe the Meal is wont by the fire to gather into little lumps, or elſe to grow ſpungy and groſs, it is convenient to grind it over again, before it be incorporated, the beſt way of all as has been ſaid were to burn it in the ſtone, becauſe it facilitates and ſaves a great part of the grinding, and avoids the inconvenience of the fine Silver flying away in the ſmoak, and where the Oar is incorporated in hard Peble and Flint, which are very untractable ſtones, it is neceſſary to burn them. Other ſorts of Oar ought not to be burnt alone, but in Meal with the mixture which ſhall be preſcribed according to the ill qualities wherewith they are affected.

CHAP.

CHAP. XI.

Of Materials to be mixed with Oar, when they burn it.

IT is no extraordinary, but a common thing for Iron to be engendered in the Gold and Silver Oar, and the Oar, that is ſo affected, is moſt difficult for burning or fundition either; it may be diſcovered by the ſlowneſs of the heat's penetration into it, and alſo by a Loadſtone, paſſing it over the Oar, after it is well burnt, and grownd, which will ſnatch up the Iron, if there be any, and more or leſs of it, according to the quantity mixt with the Oar. This kind of Oar after it is grownd, ought to be mixed with Sulphur, or which is better with the Meal of Oar that hath Sulphur, or Antimony in it, and in ſuch proportion as the quantity of Iron in the Oar requires: when they are mingled, heat them upon the Toſtadillo untill that taking out ſome of the Meal, and Enſaying it according to cuſtome;

the Oar is found to be well conditioned. Sulphur is the deſtruction of all Mettals, gold only excepted; it hurts Tin leſs than other Mettals, and Iron moſt of all, and that is the reaſon why the Sulphur, and Iron combating with, and deſtroying each other in the Furnace, the Silver is left alone by its ſelf. In like manner is Oar cured, that contains Sulphur or Antimony, being mingled and burnt with the Oar, or droſs of Iron after it is well grownd.

That Oar which contains Orpiment, or Sandarca, ought to be burnt which Soroches, which is Oar of Lead and Sulphur; that which contains Betun black or white muſt be burnt with droſs of Iron, and pouder of white ſtones, whereof they make Lime: Beſides what hath been already ſaid, the diſeaſes of Oar may be known by putting a little of it grownd ſomewhat groſs upon a red hot plate of Iron, obſerving well what fume it makes, which if it be white or black, participates of Betunes of that Colour, if it were yellow of Orpiment, if red of Sandaraca, if it be yellow in

the

the middle, and green on the out ſides, of Sulphur, and likewiſe the earth that is drawn out of the Mines, together with the Oar, will oftentimes ſend forth fumes of the like kind of colours.

CHAP. XII.

what the Refiner muſt do before he incorporates the Caxon.

THe Refiner throughly underſtanding what has been ſaid before, the Oar being well grown'd & cearſed with that curioſity and circumſpection which is neceſſary (ſo that it need not be picked) Before he doth go about to incorporate the Caxon, and before he burns the Meal, if there were need thereof, let him ſet apart three or four pound of the Flower well mingled, and ſtirring it together again afreſh, take a ſmall quantity, & make two Enſays thereof by melting in ſuch manner, as ſhall be ſhewed hereafter; whereby he ſhall certainly know what Silver the Caxon contains, and how much he may expect to get out

of it. Laying down this ground, that the Oar is of that they call *Pacos*, and needs not burning, nor contains Copperas, nor Coppaquiras, take out ſome in the manner aboveſaid, and Enſay a pound of it by Quickſilver, but firſt pour upon the Oar a good deal of fair water, more than is ordinarily neceſſary, and let it ſtand a while, and if there ariſe a ſcum, or cream, that is groſs, or oily, ſcum it off, and let that water run out, and repeat the ſame with freſh water, ſo often, untill no ſuch ſcum ariſe, then take out ſo much water as is ſuperfluous, and put Salt and Quickſilver to it, and without any other material proceed in repeating, to caſt in thoſe too, marking well the operation of the Quickſilver, whether by accident it meets with more Quickſilver; whether it turns little or much to Lead, whether it diſſolvs or remains intire; if it faſtens upon the Oar without the help of any Material, it is a ſign, that the Oar doth attract it to it ſelf, repeat the operation ſo, untill you find that the force of the Silver, and the repetition doth waſt the

the Quickſilver, which if it do the work is excellent, and will produce the Silver in duſt as ſmall as Pin-duſt, which muſt be gotten together by ſearſing, and the remainder which is mingled with Quickſilver muſt be gotten by waſhing, and ſo you ſhall have all that the Oar contained, agreeable to the experiment, which was made by melting. The Oar of *Berenguela de Pacages* is of the quality afore mentioned, a great deal whereof was ſpoiled at firſt, by working it with materials, ſuppoſing it impoſſible there ſhould be Oar, which did not ſtand in need thereof; now adays they Refine with only Salt and Quickſilver, and get the ſame quantity of Silver, as they did by melting, which is all that the Oar contains; this Oar is called *Cobrico*, if the Enſay doth ſhew Lead, for ſo they call it, when the Quickſilver loſes its own bright colour, and looks like Lead, then other materials are requiſite to cleanſe it, that it may the better take hold of, and gather the Silver together; thoſe materials that have this virtue are Iron diſſolved,

ſolved, Lead or Tin, and Lime ſlacked, or unſlacked for ſome reſemblance it hath to Mettal; any Oar may be Refin'd with the help of any one of theſe materials, although that ſeems to b beſt, which is neareſt of kindred to the mixture of the Oar. If the duſt of the Silver and colour of the Quickſilver be dusky and blackiſh, then Iron is moſt proper for it, for that which looks like Lead, Lead it ſelf is beſt to that which is clear; Tin is the beſt for Quickſilver that looks as if it were guilt and hath Copper in it; Lime is the beſt this material which is moſt convenient they throw in by a little and a little at a time by meaſure and weight, untill the Quickſilver look clear, and lay hold on the Silver, and by this they make the account by the great, how much materials they are to put into a Caxon or Cheſt, according to the number of kintals it contains.

If the Quickſilver be changed into white pouder or Aſhes, and often paſſing it again through the Oar, do not make it finer, it proceeds from the weight

weight and ſolidity of the Oar, the proper accidents of thoſe they call Soroches and Magagitaes, and thoſe other Oars that ſparkle and have need of burning, as have been ſaid before. Hard ſtones that have no Silver in them cauſe the ſame accidents in Quickſilver, wherefore looking upon it reduced to white pouder as aforeſaid, if you do not diſcern either black Oar or Margagita amongſt it, there was no Silver contained in that Oar which was Enſaid, and is good for nothing.

If in the leſſer Enſay the Quickſilver be bright and entire, and falls to work, laying hold on the Silver, there is no need of uſing any other material, all Enſays are made with a very little Quickſilver, that there may be room to uſe any other materials, if there be occaſion for it, if not that more Quickſilver may be added, and ſo the work of Refining is perform'd with greater brevity and ſecurity, as ſhall be ſhewed hereafter; and let not the Refiner ceaſe making experiments, untill the leſſer Enſay which he makes by Quickſilver, cor-

correſpond with that which he makes by melting, and let him proceed reſpectively in the greater Refining of the Caxones.

CHAP. XIII.

Continuing the Rules of the laſt Chapter, touching Oar that has need of burning.

IF the Oar have need of burning, as hath been ſaid before, and the Enſays by melting made, and the Refiner aſſured of the quantity of Plate the Oar contains, let him burn it, obſerving the rules of what he is to mix with it according to the bigneſs of the work, and the convenience he hath to perform it in, but in no caſe let him burn any Oar with Salt; beſides that it helps to calcine the Silver, it gives a ſtronger force to thoſe ill fumes which are in the Oar to penetrate into and ſpoil the Silver. One cannot well tell the ſet number of hours, wherein one ought to let Oar con-

continue in the fire, but the ſure rule to know when the Oar is well conditi-on'd, is by Enſaying ſome of the burnt Meal; when if the Quickſilver remain intire and clear, and Silver ſticking about it like driven Snow, then it is burnt enough, and the fire continued, will certainly produce this effect if the Oar be mingled with due materials, and in a juſt quantity; in order to which, as alſo in the Oars they call Pacos, let them make leſſer Enſays to know what quantity of Materials are to be put into the Furnace with every Kintal of Oar, but becauſe theſe Enſays are ſeldom made as they ſhould be, let the following rules be obſerved.

When the Oar in the Furance leavs ſmelling ill, it is a ſign that it has diſcharged it ſelf of all the Sulphur and Antimony that is in it; when that Oar charged with Betun, and at the firſt coming into the Furnace, throwing out a thick and black ſmoak by degrees, ſends forth a thinner and whiter fume; it ſhews that inconvenience to be cured.

When

When Oar changes colour, loſing the ſparkling that it had, and of *Negrillo* becoming *Paco*, 'tis a certain ſign that it is well diſpoſed for the Quick-ſilver, although in this there be exceeding great latitude.

That Oar which contains Copperas, if it be to be put in the fire, muſt firſt be cleanſed by waſhing in Meal, as hath been ſaid, otherwiſe when it comes in the Furnace, it will become very red as may be ſeen if one burn Copperas alone in the fire.

When Enſaying a little of the Meal burnt, the Quickſilver begins to look like Lead, it is a ſign that by the heat of the fire the Copper or Iron which the Mettal contains (together with the mixture of Sulphur) the Antimony or Margagita are turning into Copperas, and that the faſter, the longer the fire continues.

Take a pound of the Meal out of the Furnace, whilſt it is hot put it into a Veſſel, and pour water upon it three or four fingers deep, then ſtir it a while and let it ſettle, then if the water turn white,

white, or ſtain ones Nails, or change the colour of the Taggs of points put thereinto, it is a ſign that the Silver calcineth and diſſolves in the water like Salt; ſave this water in a glaſs veſſel, and pour more upon the Oar two or three times, or as often as is neceſſary, till it do not turn white; and all the Silver that was calcined, will be gotten out of the Oar; let the water evaporate by a gentle fire, and all the Plate will ſettle in the bottom, and become fit for uſe by melting.

If the water into which the hot Oar was put, give no ſigns of the Silver being calcin'd, dip' poliſhed Iron into it, and if it come out coloured like Copper, there is much Copperas in the Mettal; wherefore waſh the Mettal in the manner as hath been taught, untill it be cleared of the Copperas, and change not the colour of Iron; ſave the waters of this operation, for they are very uſeful in the Refining Oar that have need of it, and if you ſhould take out and melt the Sedement that is in the bottom of that water, fine

Copper

Copper will be produced thereby, or Silver if any ſuch have been calcin'd.

Enſay the Oar ſo diſpoſed in little by Quickſilver, as hath been ſaid of the Oars Pacos, untill by experience you have found out the way how to Refine in greater quantity, ſo that you may get as much Silver as you know that Oar contains by Enſays of melting in the fire. Let no body condemn theſe for tedious and unneceſſary curioſities, for there is nothing more profitable and important in theſe matters, nor leſs commonly known; and by the care & pains of a few days the Refiner will be acquainted with the ſorts and qualities of Oar that come to his hand, and know how to proceed with them without wearying himſelf with making Enſayes; but for all that have been ſaid, the Oar never comes to be perfectly Refined, untill the Silver little or much that it contained be purified and whitned in the Meal, and it is not impoſſible to put it in that eſtate. Since the Oares Pacos of Lead may be reduced thereunto only

by

by burning, and the Negrillos and o-thers alſo that have Sulphur in them which ſtaines aud blackes the Silver, al-though it muſt be a long time in the fire before it comes to this, and both one ſort of Oar, & the other muſt have boy-lings and liquors often paſſed through them, which do cleanſe and whiten the Silver, ſuch as Millo, Allum, Salt and others, the Oar being in this condi-tion, needs no other material but Quick-ſilver, which in leſs than four days time will gather together all the Silver, and be very little conſumed it ſelf, be-cauſe the ſhort time of operation, the abſence of ill qualities and the ſeldom times repaſſing it through the Oar, will not regrind, or diſperſe it to powder, which is the principal reaſon of the loſs of Quickſilver, as ſhall be ſhewed here-after.

CHAP. XIV.

Of the nature of Quick-ſilver.

DEferring untill another occaſion, which it may be in due time will offer it ſelf to treat purpoſely of Quick-ſilver, and ſome excrements thereof, of no leſs profit than curioſity; for the preſent, I ſhall only ſay with that Phænix of Science in his intellective Art, which all do follow, who treat of the hidden Philoſophy of Mettals, that Nature hath made this body of ſo uniform a ſubſtance, and of parts ſo perfectly united, that even the fire his greateſt enemy, as the vulgar think, is not powerful enough by dividing to corrupt, and deſtory it as it viſibly doth all other Mettals and bodies in the world, except Gold and Silver. The Quickſilver retains its whole intire ſubſtance in the fire, if it be prepared on purpoſe for it, which many perſons know how to do, or elſe all of it will flye quite away in the form of ſmoak, and meeting with any

any body that refreſhes it; it will condenſe therein in its own proper form without being diminiſhed one hair, either in weight or quantity; neither alſo do the ill qualities that are ordinarily found in Oar corrupt Quickſilver in Veins wherein it is begotten, nor in the Cheſts wherein they refine, for although Copperas do diſſolve it in that manner that it ſeems to be conſumed, and being ſublimated in Copperas, and common Salt, it is transformed and turned into that which we call *Mercury*, that one would think it were totally deſtroy'd and turned into another ſpecies yet it is not ſo, but all thoſe accidents have their remedies, and it is neither impoſſible nor very difficult to quicken it again, and unite it, and in its place I ſhall ſhew how this is to be done.

CHAP. XV.

Touching the cauſes and differences, of that which is called Lis.

QUickſilver diſſolved, and divided into very ſubtile parts, is commonly called by the Refiners *Lis*, which ſhews its ſelf like an eye-brow, in the matter *Purunnia* when the Oar is Enſayed; and from it the experienced Refiners take their indication of the quality of the Oar and condition of the Caxomes; it is cauſed by the often paſſing of it through the Oar (a thing inexcuſable in the ordinary way of refining) although it hath no ill quality at all, but if it hath Coperas in it, it will grind the Quickſilver in great extreamity, as hath been ſaid. If Quickſilver be without any foraign impreſſion upon it, and be diſſolved into *Lis*, which is white, 'tis called *Lis* of Quickſilver; *Lis* of other materials, is called that which is made by Quickſilver of Tin or Lead, and *Lis* of Silver is the fine, and ſubtile

ſubtile parts of Silver, made by the repaſſing of the Quickſilver through the Oar, but not as yet joyned or incorporated with it; which when it is, they call by the name of *Pella* (which ſignifies a Ball or Pellet) Quickſilver is ſuſceptible of divers colours, which appears in the *Liſes* according to the different matter which accompanies that Silver Oar into which it is thrown; theſe colours are reduced into three *Genuses* as it were, which comprehend under them ſeveral other *Species*.

Thoſe three are { *Cleer.* / *Lead Coloured.* / *Spotted.* }

The Quickſilver looks cleer, either when the Oar hath no Silver at all in it, or when the Silver it contains is fine without any Alloy or mixture; in that caſe the Quickſilver will attract, and cloath it ſelf with the duſt of fine Silver, without loſing the livelineſs of its color; which when it changeth, they call it Leaden, for its likneſs unto the co-

lour of that Mettal, although it always is accompanied with ſigns that the Oar contains Silver, unleſs it be that the Lead, for ſo they call it, proceed from falſe principles, and thoſe have a manifeſt cauſe, although little taken notice of, as well as the other proceedings in Refining, which hitherunto have been governed by chance. It is Copperas alone (the mortal enemy of Quickſilver) which gives it the falſe colour of Lead, in like manner as it doth to other Mettals the colour of Copper; the other Lead colour is a certain ſign of Silver, becauſe ordinarily it is made in raw Oar, that is mixed with divers other bad things, the which attracting to it ſelf the Quickſilver; the Quickſilver lays hold of, and carries away both the Mettal, and alſo its bad companions, who give it that ſtrange colour; this is the ground of what is treated of in the twelfth Chapter of this Book, and the reaſon of that aſſertion, that the black or obſcure *Lis*, or colour of Quickſilver proceeds from Oar that is mixed with Iron; if the Quickſilver have

have a deep Lead colour, then it hath Lead its ſelf in its company, if it be ſomething more clear, then it hath Tin, and if it look as if it were guilt a little, Copper. Whether the *Lis* be of Quickſilver, Silver, or of other materials is eaſie to be diſcerned, for the *Lis* of Quickſilver is very fine, white, but wanting quickneſs, and when it falls together with the water into the Tray, it doth not run up and down, but remains as if it ſtuck to the bottom, and if you rub it with your finger, it will unite into lumps of Quickſilver. The *Lis* of Silver ſhines, and is like Pinduſt, or finer according to the richneſs of the Oar, when they let the water out from the Oar, it runs about the bottom of the Tray, and if you rub it with your finger, it will gather together into Pellets; the *Lis* of other materials is as it were a middle thing between the other two, and being reduced into a body by rubbing it with ones finger, it unites it ſelf with the touched Quickſilver.

CHAP. XVI.

Whether it be fitting at firſt to put in all the Quick-ſilver, and other materials at once or no.

THe Oar being in good diſpoſition, and the Refiner by the foregoing rules being aſſured how much Silver the Caxon contains, and what proportion of Quickſilver and other Materials is neceſſary to be put in, that when it comes to be waſhed, it may yield three parts of Silver Pellets, and one of Quickſilver, it may be doubted whether all the Quickſilver and materials aforeſaid, ſhould be put into the incorporating veſſel at once, or no; and the moſt part, if not all the Artiſts of this Country did uſe to do it at once; untill about twenty years ago, when I came to live in the Province of the *Lipes*, I perſwaded them to the contrary according to rules, which I had learnt in ſuch like operations, out of *Raimundus Lullus*, which do evidently agree with

with the ordinary courſe of Nature, that brings to perfection all thing by a ſlow and gentle growth, and not ſuddenly nor violently. A very little fire is ſufficient to burn the whole world, if the combuſtible matter were put into it by little and little, proportionable to the force of the fire; but if all that matter, or an over-great proportion of it ſhould be laid upon the fire at once, it would choak it, and put it out: the natural heat of Animals is ſubject to the ſame inconvenience, and the ſame happens proportionally unto the Cheſts of Metals, beſides that by experience it is found, that the extraordinary cold of much Quickſilver, doth accidentally bind up the Oar, and hinder the Refine, as on the contrary any heat haſtens it; moreover if becauſe they have judged ill of the remedy to be put into the Cheſt, the Caxon deſpair, and the Quickſilver diſſolve, the remedy will be the eaſier, the leſs looſe the Caxon. And if there be need of uſing Tin or Lead, which cannot be applyed without Quickſilver, that will be added with

with leſs danger, the Quickſilver being in already. The ſame damage or greater follows when they exceed in the quantity of Materials, they put into the Oar which hath need thereof, becauſe it dulls and deadens the Quickſilver, ſo that it will lay hold on no Silver at all, and can very hardly ever be reduced into that condition it ought to be. After many days ſpent in repaſſing the Quickſilver, and dreſſing of the Oar, let the Caxon be incorporated and waſhed with a third part of Quickſilver at the moſt, and at firſt put in half the Tin or Lead, that is requiſite to be ſpent, for ſo the Quickſilver will the better lay hold of the Plate, and draw it out preſently before the Materials are conſumed, which they call *Aplomar*, whereby will be avoided the danger of the dry Plate, which like froth ſwims upon the water that comes out, and is the occaſion of much miſchief. If the Caxon ſtand in need thereof, proceed to put in more Quickſilver, and other Materials, always diminiſhing the quantities proportionally in ſuch manner,

manner, that it may go dry and not wet, for ſo there will be no occaſion for much *Lis*, and the Pellets themſelves will ſerve to get out the reſt of the Silver, whereby the refining will be ſooneſt and moſt ſecurely performed; if it be needful to Refine with Lime, the rule already preſcribed for Materials will not ſerve, but the Lime muſt be put in all at once, and with it repaſs the Caxon very well two or three days before you put in the Quickſilver, taking eſpecial care that you do not put in too much of it, becauſe it is the great hinderance that the Quickſilver doth not lay hold of the greater Plate, and it is more hard to correct than other materials.

CHAP. XVII.

Of the often repaſſing the Quick ſilver through the Oar and the effects thereof.

THe chief and principal end of letting it ſoak through, is to divide the

the Quickſilver into ſeveral bodies; that it may every where lay hold of the Plate, alſo with that motion it is heat, and better diſpoſed for the work; and laſt of all by that frication the Plate is cleanſed and purified (which is that they call waſting the Materials) all of them, things moſt neceſſary and important, although they cauſe an unpardonable damage, that hath been the loſs of many Millions in the waſting and conſumption of Quickſilver, for the repaſſings have been the foundation of this inconvenience, by ſqueezing the Quickſilver through the groſſer and finer parts of the Meal into ſuch little Atomes (which they call *Lis*) that ſcarce have weight or dimenſion, which when they waſh, the Caxon doth not fall down into the Tub at the bottom, but being over-drowned and mingled with the Lamas or mud of the Meal, it ſtays and is caſt away with them; this inconvenience may be prevented by two cautions, the one is, that the firſt and ſecond day after the incorporating of the Meal of Oar in the Caxon, they give not above

above two gentle repaſſings, ſo that the Quickſilver may be divided, but not into too ſmall parcels, becauſe before it hath gotten a good body of Silver, it is ſubject to part it ſelf over finely. The ſecond is as aboveſaid, that they put in the other materials dry, and not wetted with Quickſilver, putting them in by little and little when moſt it be in the proportion, one part of Quickſilver to two of Pellets. Let no body deceive themſelves, that although the Meal in the Caxon contain other Materials ſufficient, if it be much bathed with Quickſilver that it ſhall be ſecured from the former inconvenience; for contrariwiſe it will rather be ſubject to a greater prejudice, for of neceſſity the repaſſings will make *Lis*, and if it happen by ſome accident as it very well may, that the Materials be quite conſumed inſtead of the *Lis* made of them will remain only *Lis* of Quickſilver. In the *Lis* of Plate there is not that danger, that by the often repaſſings the Silver ſhould be waſted or conſumed, rather it is thereby better refined, and better

embraceth

ceth and uniteth it ſelf with the Quick-ſilver.

CHAP. XVIII.

Of divers accidents, which happen in the way of Refining by Quick-ſilver, and their remedies.

IN the progreſs of this kind of Refining, divers accidents are met with-all in the Caxones (or cheſt full of Oar grownd to be Refined) all which are diſcovered only by the Quickſilver, which as in a glaſs repreſents the good or ill diſpoſition of the Mettal, which in themſelves by reaſon of the fineneſs of the Meal into which they are grownd, and a mixture of earth in the Oar, cannot be diſcerned.

If the Quickſilver be very much charged above what it ought with materials, that is to ſay, Lead, Tin, Iron, or Lime (which the *Spaniards* call Quickſilver Tocado) it will not appear round but flatted, or rather prolonged like

like little Worms, and if you ſtir it about the Tray without water, it will make drops with little tailes, and ſtick to the ſides of the Tray; and when it is of this condition it is a ſign that it is killed, and its virtue obſtructed from laying hold of the Silver; this evil is remedied bv much repaſſing, not without great coſt and expence of time; the quickeſt and moſt efficacious remedy is Copperas, or the water thereof, which I have ſhewed how to make and to keep in the 13. Chapter of this Book, put it into the Caxones at the ſame time as you do the Quickſilver, and other Refining Materials more or leſs, according as there is occaſion, and you ſhall inſtantly ſee the effect of it; the reaſon whereof is plain, for (as hath been ſaid) Copperas diſſolved in water converts the baſer Mettals into true Copper; ſo that the quality of cold which they had before, and wherewith they choaked the Quickſilver, being turned into heat (the property of Copper) it is the cauſe of reviving the Quickſilver: From hence is grounded

the

the practice of putting Copper grownd ſmall into the Caxon, which is found very profitable for the purpoſe aforeſaid; hence alſo it comes to paſs, that all Oar of Copper although it be rich is not proper to clear Quickſilver with, or to be uſed in the Refining to make it Aplomar, unleſs it have a great deal of Verdigreaſe or Copperas. The ſame account may be given of the Virtue that is found in thoſe they call Magiſtrates, which they uſe in the Refining to qualifie the Caxones with heat, and to make them Aplomar, the which effect is produced from the burnt Copperas that is in it, as may be ſeen in their compoſition, which for better ſatisfaction I ſhall here ſet down.

Burn Oar or Copper, and grind it well, then with an equal quantity of Salt knead it into a body together, and having made it into loaves burn it again.

Others do mingle but one part of Salt, with two parts of Copper Oar, which they make up into a body and burn, and to one Kintall of that beaten

to

to pouder, they add half a pound of filings of Latin. Brass or Zin? (see p. 143)

Another Magiſtral is made of Lamas. probably tailings - H. Wurtz

Relabes and Salt, an equal portion of either ſoundly burnt together.

Another is made of that Oar wherewith they Refine the Relabes and Salt put together in equal portions.

Another ſort may be made of Copper Oar, Relabes, Meal of that Oar which is to be Refined, droſs of Iron and Salt, all put together in equal portions and burnt in loaves.

Another is made of three parts of the Lamas burnt, and one part of Salt. Every one inventing ſuch like compoſitions or proportions, according to his own fantaſie, and experience: the foundation of all theſe Magiſtrales being the Copperas which the fire produces in them, as may be ſeen and ſeparated from them, by whoſoever ſhall pleaſe to go about it according to the rules that have been already delivered, which ſeems to confirm that which *Pliny* ſays,

Lama is the name applied to one pulverized in an arrastra - G. J. B

treating of Copper, namely that it is begotten of ſtones burnt.

Theſe Magiſtrales are to be uſed with the ſame carefulneſs as hath been already ſaid of the materials, namely they are to be made trial of before the incorporating of the Caxon, that by theſe leſſer Enſays it may be known what proportion is fit to be put into the Caxon, according to the number of Kintals it ſhall contain, for if the proportion do exceed, another great inconvenience will be produced thereby, namely that which follows.

CHAP. XIX.

In proſecution of the Chapter foregoing.

AN Accident contrary to that mentioned in the former Chapter, and an occaſion of great waſte of Quickſilver, is of the colour of Lead, that is to ſay, when it is affected with no other mate-

material of inconvenience, but only that diſcolouration, and the damage is the greater, if the diſcolouring hath proceeded from Copperas, and that there be much Quickſilver divided, and running looſe about. Quickſilver ſqueezed out of the lumps is very round and lively; if it be divided, the parts of it, although never ſo ſmall, do not run into a Cylindrical figure, but into a Spherical, this miſchief is cured by the contrary materials, which as hath been ſaid before cleave unto the Quickſilver, nevertheleſs the Medicine, which by its particular qualities, attraction, and natural ſympathy cure this evil is Iron, which reunits the Quickſilver, and gathers it together into a body after it was diſſolved, corrupted, and in a manner turned into another ſubſtance by the Copperas, which ſhall be treated of more at large hereafter, when we ſpeak of waſhing the Caxones.

No certain rule can be given, what quantity of materials to put into the Caxones, that have failed in the operation, becauſe the miſchief and the cauſes

thereof are not always the ſame; but this general rule muſt be obſerved, that they do not repaſs the Caxon with Quickſilver, till they have firſt Enſayed a ſmall quantity thereof, and thereby have underſtood what is neceſſary. After that let them take a third or a fourth part of the Caxon, and mingle that with the whole proportion of the Materials, and ſtir it well together, till it be very well mixed, and incorporated one with another, then mix this with the reſt of the Caxon, ſtir them very well together, for after this manner the Medicine will be beſt, and with moſt equality diſtributed in the Caxon, eſpecially if the Medicine to be put in be very ſmall in quantity. Have a care to uſe the means, that is requiſite to avoid falling into the firſt inconvenience of overcharging the Quickſilver, and remedy the ſecond miſchief with all poſſible ſpeed, becauſe otherwiſe the Copperas will tranſform the Quickſilver in ſuch manner, as if it were quite eaten up and conſumed. When Enſaying the Caxon the Quick-

ſilver is found in the bottom of the *Purrummia* Veſſel divide it in ſmall grains not run together in a lump, it is a ſign the Refination is imperfect, and that ſome little hairyneſs, or criſping encompaſſeth the Pellets of Quickſilver, and hinders them uniting; the want of materials is commonly the cauſe of this, or elſe the over-much allay of other Mettals, which as well as the Plate attracts the Quickſilver it ſelf. Repaſſes, the Relabillo burnt by reaſon of its ſharp cutting quality is profitable to cleanſe the Quickſilver: ſome put in aſhes, but the moſt proper and natural remedy for it, is that which they call Millo or Allum, which makes the Silver white, and is very ordinarily to be had in great abundance amongſt the Mines here at *Potoſi*, and in *Guaico de Santiago* there is a Spring that runs continually with this Allum water.

divided?

When the Caxon hath not been repaſſed equally, or not ſerved with as much Quickſilver as is neceſſary, or in ſome places doth not unite it ſelf with other parts of the Quickſilver, that had

gotten Plate already, the cauſe thereof is that they call dry Plate: In Enſays you ſhall ſee it ſwim upon the Relabes criſped like froth, and if it be not ſcimmed off, and ſaved before the cleanſing the Caxon, it will ſwim at the top, and run away with the Lamas to the great detriment of him that owes the Oar; if the Quikſilver dry, having nevertheleſs materials ſufficient with it, it is no inconvenience at all, becauſe it will unite one with another the better, or elſe that part which the material poſſeſſed being waſted away, the other moiſt parts remain in the Quickſilver to unite it ſelf with the reſt of the Pellets; that dry Plate which wants materials, cannot ſafely be gathered together by looſe Quickſilver, untill the Caxon be ready for cleanſing; the proper remedy for this is to repaſs the Caxon with Pellet of Silver, not over ſmall, ſo ſhall the dry Plate be collected together, and the greateſt part of the *Lis* alſo, if there were any there.

CHAP.

CHAP. XX.

How to know whether or no the Caxon be ready for washing.

THere can no certain time be prefixed, wherein one is obliged to wash the Caxones. It's maturity is hastened by frequent repassings by the outward heat of the Air, and the inward heat of the Copper or Copperas, and other things of that kind of virtue, and such as clear and purifie the Silver; a principal cause whereof is the burning of Mettals. On the contrary, the work of Refining is prolonged and slackened by fewer repassings, if the Air be cold or Frost, if the Caxon be over foul, that the Quicksilver loses it's clearness in passing through: but letting pass these, and other accidents, let us come to the point of gathering out the clear Silver mixed with Quicksilver, leaving the earth behind, which is called washing the Caxon, whereunto no small experience is necessary, for if the

Caxon be not ripe for waſhing, that plate which the Quickſilver hath not laid hold on, is likely to be utterly loſt, or if it be not, it muſt be grownd over again, ſo that at leaſt one loſes much time and labour, and Silver too in the repaſſings, beſides other hazzards.

The rules hitherto delivered for the diſcovery of the diſpoſition of the Caxon are ſubject to very great error: ſuch as it's appearing ſo well to ſight as if there were need of no more Quickſilver; to find the *Lis* of the Plate all gathered together and finiſhed, and that of the Quickſilver beginning to come; the ſubſtance of the Plate, and Quickſilver being clear, and gilded as it were with other ſigns, all of which do not ſecure the judgment from being erroneous, becauſe theſe may be produced by other accidents beſides the maturity of the Caxon. The only ſure and infallible ſign is to ſee whether the Quickſilver hath gotten all the Plate, which it ought to do according to the proportion ſhewed by the leſſer Enſay of fire, which was made at the beginning, and if it hath

hath not arrived to that, although it hath many more good ſigns than hath been already mentioned; waſh not the Caxon, but take more ſmall Enſays thereof, whereby you ſhall eaſily prove what Plate it contains, and what remedy is neceſſary to bring it to full perfection, which when it is attained, and the refined ſubſtance alone contains the aforeſaid proportion of Quickſilver and Pellet, ſtrow ſome Quickſilver looſe upon it, and therewith gently repaſs it two or three times in ſuch manner as it may go into the Copper better bathed, in the proportion of three parts Pellet, and two of Quickſilver, or at leaſt two of Pellet and one of Quickſilver; then gather up ſome of the *Lit* that remains, and put it to the dry Plate, and to the whole Maſs of Pellet, whereby they will be more weighty, and ſink better to the bottom of the Caldron, and will riſe and waſt leſs in the boyling; throw Quickſilver alſo looſe into the Caldron (which they call a Bath) when it begins to be liquid, incorporate therewith that which the Caxon contained, and it will

will help to unite it the better, and the more Quickſilver there was, the fewer inequalities like Oyſter ſhells will be produced.

CHAP. XXI.

That the waſhing of the Caxones cauſeth the loſs and waſte of Quick-ſilver.

ALL the inconveniences that are and have been found in the waſte of Quickſilver, which they term either loſs or conſumption of it, are cauſed by the waſhing the Caxons; until then nothing hath been loſt, however one may be deceived in Judging by the view even in occaſions, that have ſometimes happened and may happen again, that they find neither Quickſilver nor Pellet of incorporated Mettal in the Caxon; for accidents alone as hath been ſaid, cannot alter the Quickſilver ſo as to corrupt and deſtroy its ſubſtance; in the Caxon it is howſoever more or leſs diſpoſed to get out inperceptibly with the

the water or with the Lamas. The immediate cauſe of this miſchief is when the Quickſilver is made over thin without body or weight as it were, ſo that it hath nothing to ſink it to the bottom of the Caldron, and with the ſtirring the Caxon when they waſh it, it mixeth it ſelf with the dreggs and durt, and goes along with them, and there wants more or leſs of the Quickſilver they put in at firſt, according to their better or worſe ſtirring the Caxon and quantity of *Lis*. It hath been a great error in thoſe, that becauſe for ſo many years the beſt Refiners in theſe Kingdomes have waſted at the leaſt ſo much Quickſilver, as they have gotten Plate, therefore the Quickſilver is really and truly conſumed in the operation, not animadverting the evidence to the contrary, which continually paſſeth through their hands, namly in the Lamas and relicks of the Caxon where the Quickſilver hath oftentimes ſtayed behind, accompanied with a conſiderable quantity of Plate, which the owners of Oar have experimented to their great damage,

and

and the buyers and Refiners of the relicks of the Caxon to their great profit and advantage. Others ſpeaking Philoſophically ſay, the cauſe of the conſumption of the Quickſilver proceeds from the contention and combat, which it hath with contrary qualities before it can lay hold on the Plate, and that thereby it is debilitated and conſumed; theſe men ſay ſomething to the purpoſe if they could demonſtrate the contrary qualities that are between Quickſilver and other Mettals, between whom there is rather a great ſympathy & agreement, Quickſilver being the principal whereof all other Mettals are made, and alſo of the Minerals that ordinarily do accompany them, but if theſe men cannot prove the cauſe, neither will the effect which they ſuppoſe, namely the deſtruction of Quickſilver follow, and there is certain experience to the contrary, and hereafter ſhall be ſhewed a way how to recover all the Quickſilver, even out of the Caxon, that is moſt ſpoiled in operation, and ſo moſt difficult to do it in.

CHAP.

CHAP. XXII.

The true cauſes of the loſs of Quick-ſilver, and their remedies.

THe repaſſings are the remote cauſe of waſting of the Quickſilver, which is thereby ſtrained and divided into very ſmall parts which they call *Lis*, and although into whatſoever Oar, Earth or Sand you throw Quickſilver, and repaſs it, you ſhall find the effect aforeſaid, yet it is moſt of all experimented in thoſe Oars which are called Soroches, which by their weight and glaſſie quality, do more eaſily cut aſunder, and divide the Quickſilver into minute parts.

Copperas is of its own nature a violent cauſe of extenuating the Quickſilver, as hath been often ſaid, and hath been the cauſe of the waſt of the greateſt part of the Quickſilver that hath been deſtroyed. There be other cauſes, which accompany and aſſiſt the two former in working this ill effect, one is the

the Salt, which they uſe in Refining, and wherewith they waſh the Caxones, which every body knows thickens water, whereby not only the ſmall *Lis* of Quickſilver, but alſo heavier things ſwim and cannot ſink to the bottom.

The Lamas which is mingled with the water, and troubles it in the Caldron thickneſs it, and doth yet more reſiſt the ſinking of the Quickſilver which ſtays and is thrown away together with it.

Laſtly, the motion of the inſtrument wherewith they ſtir the Caxon when they waſh it by condenſing the force of the cauſes aforeſaid, hinders the *Lis* from ſinking, and crowdeth it up to the top. The ordinary repaſſings in this way of Refining cannot be wholly excuſed in this matter, but if the rules already taught, be carefully obſerved, the damage will be the leſs: likewiſe already hath been ſhewed the way to clear Oar from the Copperas, and to clear the Margagitas from their heavy and glaſſie qualities. Salt may be gotten out of the Caxones two ſeveral wayes, and pre-

preſerved for uſe to the ſaving of many Ducats a year, now commonly ſpent in that commodity; put the Oar into Caxones made ſmooth and round on the inſide without corners or Angles as is often uſed, let them ſtand a little ſlooping, only ſo much as is neceſſary, that all the water may run to one part of it, where there muſt be a hole for it to run out at in convenient ſeaſon, but ordinarily kept ſtopped. When the Caxon is ready for waſhing, fill it with abundance of water, opening and ſtirring about the Oar with the hove, that the water may penetrate through it the better, and having done ſo a pretty while, open the hole, and let the water out into a Veſſel provided on purpoſe to receive it, where it will either congeal into Salt, or remain in liquor as it is, will be ſerviceable for the operation of other Caxones; repeat this two or three times untill the water that comes out doth not taſte brackiſh. If the Caxon was to have been waſhed in three Caldrons waſh it in ſix, whereby the water will come out twice as clear,

clear, and with very little Mud, or Sediment.

The Peſtel wherewith they ſtir the Caxon, muſt not be uſed always in the ſame hand, becauſe the cricles going conſtantly paralel, the ſmall parts of the Quickſilver, and the dry Plate go along together with them, and never encounter one another to unite themſelves into a bigger body that they may ſink to the bottom, wherefore after five or ſix turns with the right hand, take as many more of the left, and ſo proceed; and becauſe this cannot ſo conveniently be done in the ordinary waſhing places, put into the Caldron a thing like a broad Peel, which oppoſite to the courſe and motion of the peſtel may diſturbe the march of the Quickſilver and dry Plate, and cauſe all the content of the Veſſel to meet and unite, excepting that which is at the bottom whereof there is no neceſſity, becauſe of the bath which it is to ſuffer. Cover the Veſſel with Plates of Copper, or Iron Quickſilvered, to which ſide ſoever of the Veſſel the *Lis* comes, it

may

may ſtick thereunto, when the Caxon is waſhed the *Lit* is eaſily gotten together, by ſweeping the ſides of the Veſſel with a peece of ſhoo leather, a peece of a hat, or a peece of cloath.

CHAP. XXIII.

To make the Pine Apples, *and to clear them of the Quick-ſilver.*

HAving taken the Plate and Quickſilver together out of the Caldron, and ſtraining it through two courſe cloaths wetted, to make them the thicker, having beaten it alſo with a Battledoor to ſqueeze as much Quickſilver through the cloathes as is poſſible, make Pine Apples of the dry Pellets in moulds fitted for that purpoſe, which are called Pine Apples from their ſimilitude to that fruit by reaſon of their Pyramidal figure, and

of thoſe Pines that have been reaſonably well ſtrained, the fifth part will be Silver, ſo that one Hundred pound of Pellets will produce twenty pound weight of Silver. The Pines that are made of richer Oar ariſe to leſs profit than thoſe that are made of poorer, becauſe the Plate in the richer Oar is more courſe and ſpungy, than that which is contained in the poorer. In the ſtraining of the Quickſilver though never ſo carefully, ſome ſmall parts of the Silver will go along with it, and the more in quantity by how much the more moyſture there was in the Pellets when they began to ſtrain them, the like whereof is ſeen in water mixed with clay, which although it be ſtrained with never ſo much care, will not look clear and pure but muddy and troubled by reaſon of its mixture with the durt, and the great quantity of water there was, the more durt ſtraines through along with it; letting it ſtand quietly a while it will ſettle and gather it ſelf together, and leave the

the water clear. In like manner, in the Veſſels wherein they preſerve the Quickſilver after they have done refining, and made the Pine Apples, after a few days the Pellets of Silver will ſettle and gather into a body together. In the refining work of Saint *Catherines* in the *Lipes* out of the Veſſel, wherein they kept their Quickſilver, I ſaw as much Plate gotten of the kind aforeſaid, as would have made a good great Pine Apple.

If the Quickſilver be heated it becomes thinner, and will carry away more Silver in the ſtraining, alſo when the Pellets are ſtrained, that are gotten by boyling although it be done with very much care, yet Plate will paſs along with the Quickſilver, and if you will let it ſtand a days time to cool and ſettle, and ſtrain it again, you will get more Pellets of Silver.

The loſs in clearing the Oar again from the Quickſilver hath been great and irrecoverable, as may be gueſſed from the experiment thereof in this Imperial City at this preſent, when the Trading in Mettals runs but low, and yet *communibus annis* above thirty thouſand peeces of Eight are waſted by the expence of Quickſilver, how vaſt a ſum then hath been ſpent by Quickſilver in the many other very rich Mines belonging to this Kingdom; this inconvenience hath proceeded from want of care in ſeeing that the Canones and Caperucas(which are the names of the Veſſels they uſe in the recovering the Quickſilver) be made of very good ſtuff, and ſhut curiouſly cloſe in the Place where they joyn together. The clay whereof uſually they are made is very ſpungy and full of Pores, ſo that the water ſoaks through and ſweats out at them; then it is no wonder that the Quickſilver attenuated by the violence of the fire (which widens the Pores

of

of the Veſſel alſo) evaporates through the ſame, and is exhaled and loſt: to ſay that any part of the Quickſilver is deſtroyed or periſheth by the heat of the fire is onely the imagination of thoſe that underſtand not the uniformity of its ſubſtance, as hath been ſhewed before. Make the Caperucas and Canones of ſuch ſtuff as you make the Cruſiples, and that inconvenience will ceaſe, and the Veſſels will laſt for ever (becauſe they are ſo mightily condenſed and reſiſt the fire) unleſs ſome accidental blow or knock do break them. In that noble Town of Saint *Phillipi* of *Auſtria*, *Oruro*, famous for abundance of Mines both of Gold and Silver, on the top of a little hill which ſtands above the Church of the *Ranqueria*, there is a little vein of white earth, whereof they make Veſſels for uſe, which after they are baked become ſo cloſe and firm that they are not inferior to the beſt *China*. I was the firſt that made try-

all, and publiſhed the uſefulneſs of it for the making of Cruſiples with very good ſucceſs to thoſe that had need of them, and I do not doubt but there is ſuch kind of Earth about this City of *Potoſi*, where nothing hath been found wanting that any wiſe belonged to the obtaining or refining of that abundance of riches, which nature hath beſtowed upon it; although hitherunto much buſineſs, and a ſhort time of abode here, hath hindered me from finding of it out. But where ſuch kind of earth is wanting, mingle the Clay whereof you make theſe Veſſels, the better with the ſcum or droſs of Iron grownd very fine, and make it up and bake it very well, and there ſhall not be ſo much Quickſilver loſt in the uſe of them as is by thoſe now in common uſe. The Canones muſt be glaz'd on the inſide, the Caperucas not, becauſe the violent heat will melt the glaſing, and make it run.

CHAP.

CHAP. XXIV.

Other ſafer ways of clearing the Pine Apples from Quick-ſilver.

THe beſt Veſſels for this purpoſe are made of Iron or Copper beaten to the thickneſs of a peece of Eight, or ſomewhat thinner, and for more ſecurity, that the Veſſels may the better endure the fire, they cover the Copper Veſſel with a coat of good earthen ware on the outſide; not many years ago, ſome people began to uſe theſe Copper Veſſels caſed with earthen ware, and left them off again, becauſe they underſtood not the nature of them, nor how to uſe them. The like happened in the Province of the *Chickas*, who caſed their refining Veſſels as aboveſaid, becauſe they heard that in their neighborhood in the *Lipes*, I was working after that

manner. The cauſe of theſe miſtakes ſhall be ſhewed in the diſcourſe which follows.

The ſhorteſt, beſt, and moſt ſecure way of clearing the Pine Apples from Quickſilver is in this manner; make a deep Veſſel of Iron wider at the top than at the bottom, containing more or leſs according to the quantity of Mettal intended to be cleared at one time, ſet it upon a Trevet of ſtrong Earthen were, or of Iron caſed with Earth in a Furnace of ſufficient bigneſs to put Wood or Coals under it, as occaſion ſhall require at a mouth made for that purpoſe; the reſt of the Furnace both the top, bottom, and ſides is to be very cloſe; excepting one little hole at the top where it ſhall be found moſt convenient to give reſpiration; diſpoſe the Veſſel aforeſaid in ſuch manner as they do that which they call the Cannon in the ordinary way of uſing Quickſilver; ſo that it may look out above

the

the top of the Furnace one large fingers bredth or two, that it may the better joyn with another Veſſel to be put a top of it, which may ſerve inſtead of the Caperuca; put the Pellet (or Mettle aforeſaid) well kneaded together in Cakes of what form you pleaſe into the Veſſel, and leſt the Plate ſhould melt and ſtick to the Iron Veſſel, let it have a thin coat on the inſide of Earthen ware; or ſuch as Cruſibles are made of, cover this Veſſel with a large Limbeck head made of hammer'd Iron, or Copper, or of very good Earthen ware well glaz'd, and out of it draw a long Pipe a little ſloping, the cavity whereof in the narroweſt Place, namely the extremity, let be no leſſer, than the bigneſs of ones little finger, let the joyning of the Limbeck with the Veſſel below it, be ſtopped very cloſe with galt, then in a ſecure place that doth not feel the heat of the Furnace, let there be placed a great Veſſel of ſtone or of other matter full of cold water, where-

whereinto let the noſe of the Limbeck enter two fingers breadth, blow up the fire in the Furnace from which the Quickſilver flying in the form of vapor to the top of the Limbeck, the coolneſs whereof preſently reduceth it into a body again, which runs down through the Noſe into the Veſſel of water aforſaid, the Limbeck ſhould now and then be cooled on the outſide with wet cloaths, and the water into which the Quickſilver falls as it becomes warm ſhould have more freſh water added to it.

A. The deep Veſſel of Iron, or Copper.

B. The head of the Limbeck.

C. The Noſe of it.

D. A Trevet.

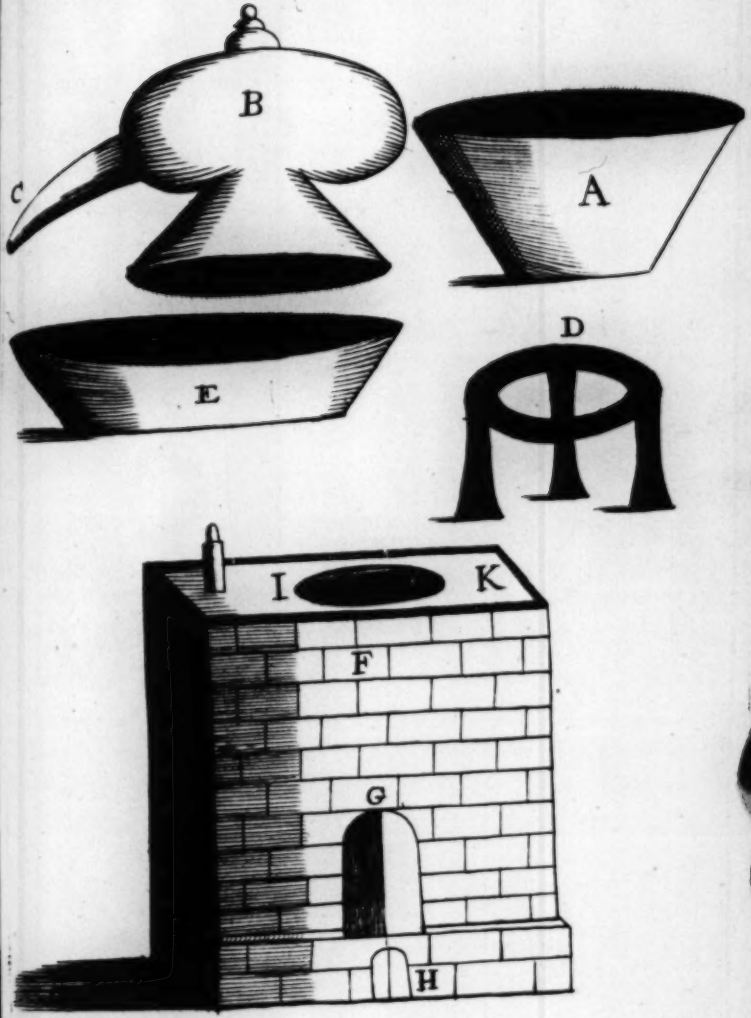
E. A Baſon or Veſſel of water to receive the Quickſilver in.

F. The Furnace.

G. The Mouth of it.

H. The hole to draw out the aſhes at.

I. A



Lib: 2 *pag.* 88.

I. A hole open at the top of the Furnace, whereat the deep Iron Veſſel looks out a little, and is joyned to the Limbeck.

K. Is a Chimney to let out ſmoak and give reſpiration to the fire.

Here place the Pictures and the Verſes.

The

The trouble and hazard of keeping them close in the joynt with clay or galt, may be excused by making of the place where they shut one upon the other a handful and a half higher, or if to that size of them, that is now in use they put at the bottom on the outside, and fill it of two fingers broad; so that the lower Vessel may come up very close upon it, and cannot enter further into it, a little lower than the Caperucas come, are placed the Candlestick foot, as they call it, whereupon they set the Plate and the Pine Apple; the Candlestick foot comes up about four fingers higher than the mouth of the lower Vessel, which they call the Cannon in the which on the one side four or six fingers lower than the fire used to be, enters in a small Pipe of cold water at a hole made for that purpose in the Cannon without disturbing the Caperuca at all, because it is not to go in strait, but with a little liberty; over against this hole there is such another, out of which runs as much water as enters in at the former,

former, whereby the Canon is always kept full, and the water in good temper to receive the Quickſilver without any prejudice.

If one ſeparates the Quickſilver by the Limbeck, they may do the ſame thing, clapping a ring of Copper of two fingers breadth, and other twofingers deep to the mouth of the lower Veſſel; ſo that the other Veſſel may eaſily be let in and out, wherein the Quickſilver is to be ſaved. Into this Circle the Limbeck muſt be fitted, and to prevent its being blown off with the force of the vapor of the Quickſilver, the Limbeck muſt be kept down with weight on the top of it, or tying it to ſome other fixed thing, or making a ring on the top of the Limbeck paſs a bar of Iron through it, both ends whereof afterward remaining fixed in two walls built on each ſide of it for that purpoſe.

FINIS.